FEBRUARY 1957 Vol. 19 No. 2

MINING WORLD

Union Miniere's Golden Jubilee

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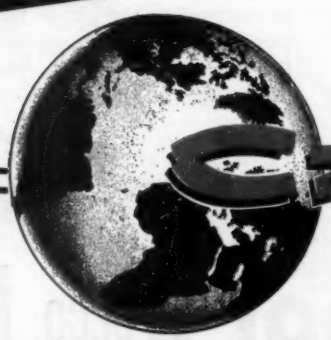

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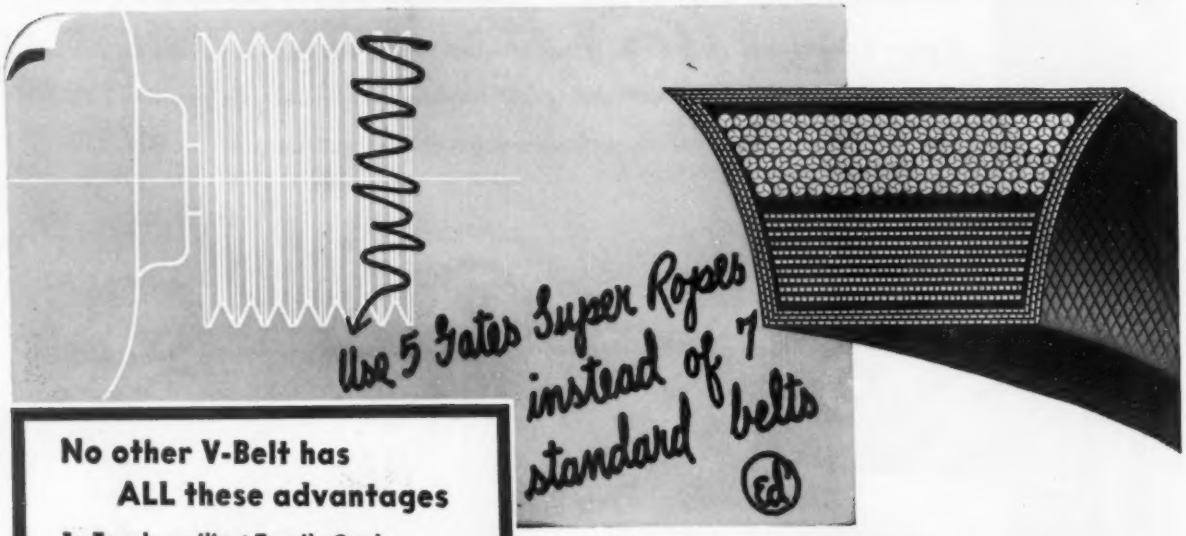

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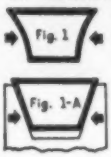

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Mining World

Including the Export Edition **WORLD MINING**

Published monthly except in April when publication is semi-monthly

VOLUME 19 **FEBRUARY 1957** NO. 2

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BY EDGAR SENGIER

Results and achievements of company are contributed to the advancement of mining and metallurgical technology.

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How Musonoi Open Pit Was Developed With United States Equipment 40

BY E. WEBERG

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BY E. DEFOURNEY

More than 1,000,000 metric tons of ore mined annually by 90 Europeans and 2,200 natives. Unique ventilation and hoisting systems.

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BY THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

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BY THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

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BY THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

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ON THE COVER

Casting cobalt ingots at Jadotville. Training of natives for industrial positions has advanced ahead of technological improvements.

READERSHIP

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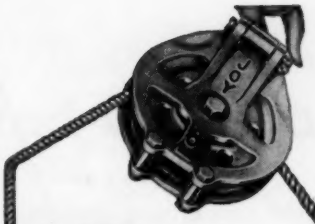
MILLER FREEMAN PUBLICATIONS



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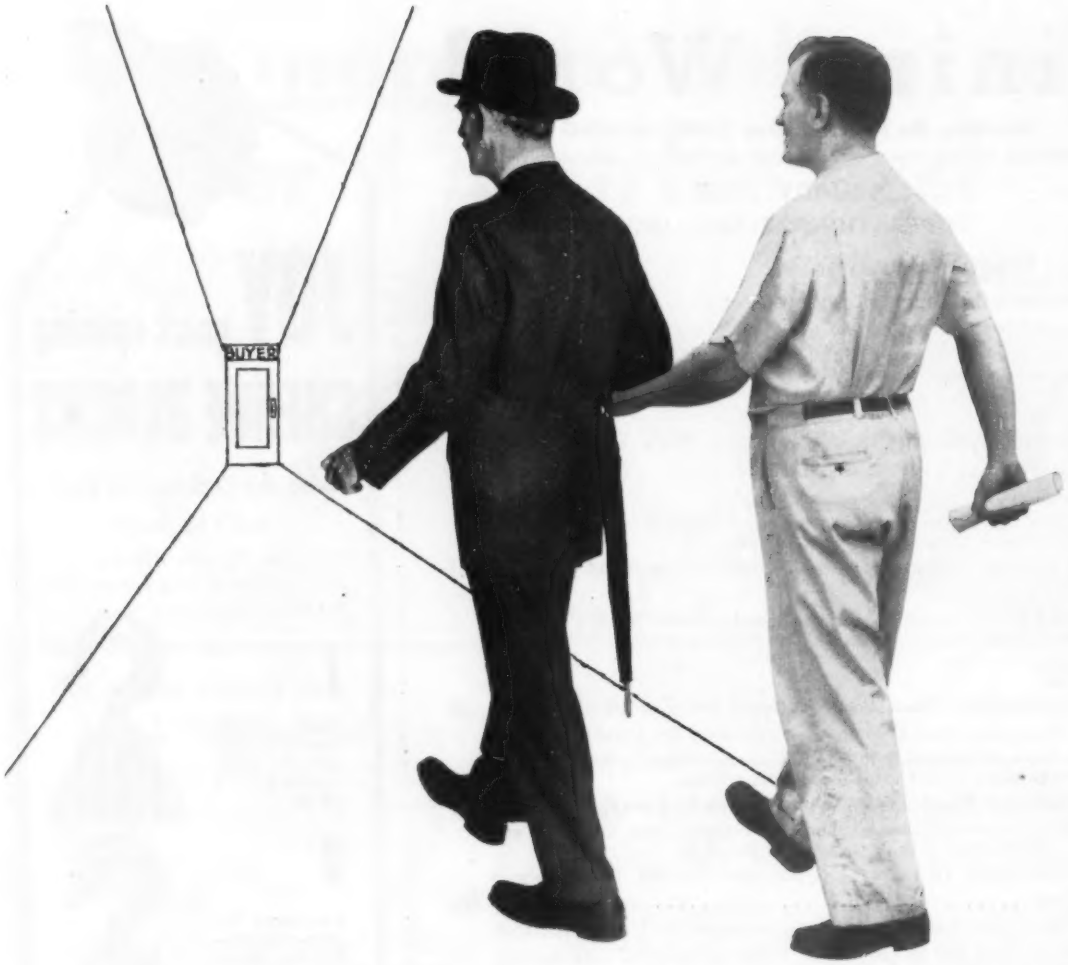

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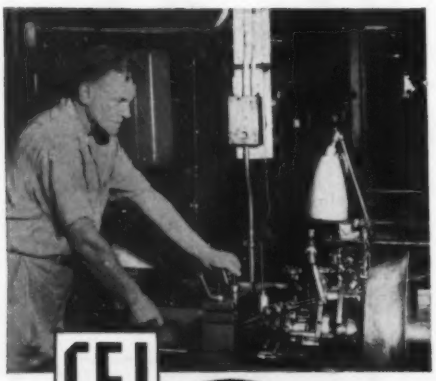

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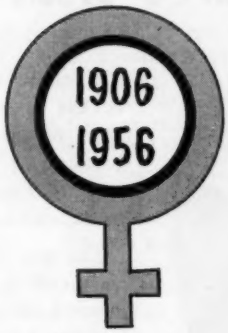
Drifts and Crosscuts

Union Miniere: Truly a Great Mining Company



It is again with great pleasure that MINING WORLD has the opportunity and privilege of presenting a special issue devoted exclusively to one of the world's great mining companies. It is most fitting that the technical and human engineering accomplishments of the Union Minière du Haut Katanga in the Belgian Congo be the subject of this Commemorative Issue in celebration of the company's recent Golden Jubilee.

Now Union Minière joins A/S Sydvaranger, O'okiep Copper Company Limited, and the Philippine mining industry as the subject of an exclusive technical issue.

These and other equally enlightened companies have been most generous in the free exchange of information and experiences which have done so much to raise the high technical standards of the entire minerals industries for the betterment of all. This spirit of cooperation can no better be outlined than was done by Edgar Sengier, Union Minière's permanent chairman, in his introductory message, as follows: "I sincerely wish that the publication in MINING WORLD of the problems with which we are confronted may be a useful contribution to the rapid technical progress which the mining and non-ferrous metal industry has steadily realized in the course of these last decades."

Union Minière's accomplishments have been modestly outlined by the staff in the chapters of this magazine. The special UMHK symbol reproduced on this page is used with the title for each chapter in this issue. Everyone in the metal consuming world will recognize it at once because each and every billet, bar, pig, ingot, stick, and slab of Union Minière metal is branded with it.

The history of Katanga is a repetition of the history of other regions of the world where mineral deposits were the only possible reason for their development; where, in spite of other possibilities the regions might offer, they were insufficient to justify the enormous investments needed to develop a new country.

Technical achievements, while notable and perhaps more readily apparent, have, of necessity, gone hand in hand with the more important social and economic improvements for the African population. The enlightened policy of Union Minière has given the Native the full sense of civilization and accomplishment with the fortunate and happy result of no interracial tensions. What a contrast to other parts of the African continent!

COMING CONVENTIONS

February 7, 8, and 9, 1957. National Western Mineral Conference and 60th Annual Convention of the COLORADO MINING ASSOCIATION, Shirley Savoy Hotel and Mile High Center, Denver, Colorado.

February 24 through 28. Annual convention of the AMERICAN INSTITUTE OF MINING ENGINEERS, Roosevelt and Jung Hotels, New Orleans, Louisiana.

March 3 through 6. Silver Anniversary Convention of the PROSPECTORS AND DEVELOPERS ASSOCIATION, Toronto, Canada.

March 3rd through 9th, 1957. Joint meeting AMERICAN SOCIETY OF PHOTOGRAMMETRY and AMERICAN CONGRESS ON SURVEYING AND MAPPING, Shoreham Hotel, Washington, D. C.

March 11 to 15, 1957. ATOMIC EXPOSITION AND NUCLEAR CONGRESS, Convention Hall, Philadelphia, Pennsylvania.

April 5, and 6, 1957. PACIFIC SOUTHWEST MINERAL INDUSTRY CONFERENCE, sponsored by the Nevada, San Francisco, and Southern California sections of the AIME, Reno, Nevada.

April 16, 17, 1957. HIGH TEMPERATURE MATERIALS CONFERENCE, Cleveland Section of the AIME, Hotel Carter, Cleveland, Ohio.

May 28, 29, 1957. SECOND REACTIVE METALS CONFERENCE, Southern California Section of AIME, Ambassador Hotel, Los Angeles, California.

For air-leg drills and light stoping...

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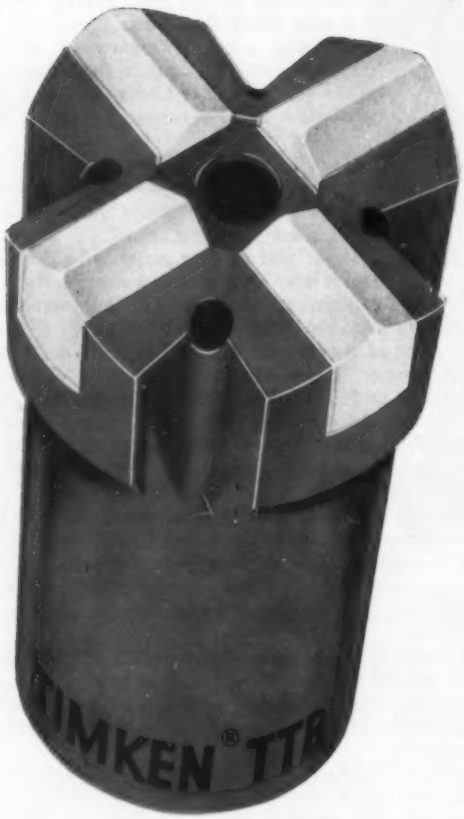
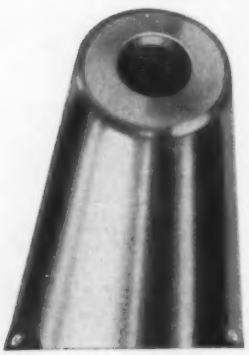
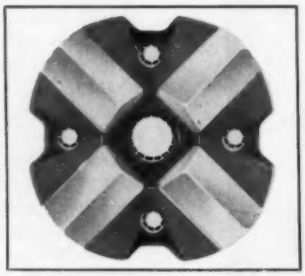




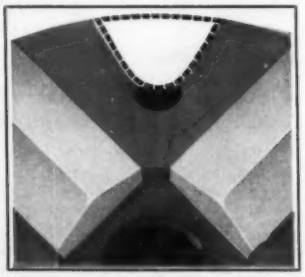
This new Timken® removable bit has a uniformly tapered socket to provide a more secure union between bit and steel for air-leg drills. The tapered socket reduces bit breakage, permits quick and easy bit changes. And the bit body of Timken electric furnace fine alloy steel is the finest to be found in a rock bit today.

You get superior wear-resistance with added shock resistance from the special analysis carbides in the new Timken tapered socket bit. It holds its gauge longer, drills faster, and can be reconditioned many times to give you lowest cost per foot-of-hole. It is available in three popular sizes—1¼", 1⅜" and 1½".

THESE TWO NEW FEATURES SPEED CHIP CLEARANCE



5 front holes are specially positioned to direct water against the face with jet action to wash chips away faster. Larger center hole has plug dropped deeper for freer cutting action. New frontal design adds life to bit.



Wider, deeper clearance between cutting wings works in conjunction with five front holes for speedier removal of washed-back chips. Speeds drilling, increases cutting efficiency, helps to lower cost per foot-of-hole.

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Capitol Concentrates

Congress and The Mining Industry Await Interior's New Mining Plan

As far as new mining legislation to be introduced in the first session of the 85th Congress is concerned, do not expect anything important until the Seaton-Wormser proposals are before the Interior Committees for study. Outside of the pressing necessity for additional appropriations for Public Law 733 (the strategic minerals purchase act), only a few minor measures which probably will be outside of the Seaton-Wormser proposals will be considered. If a careful study by the Senate and House Interior Committees fails to reveal a practical long-range plan which also will be of current benefit, you can expect the Congress to give the program a thorough going over. Also, a number of Senators and Congressmen may be forced to introduce their own—and probably piece-meal—bills to help their own sections of the country, looking toward the cessation of the government's "stop-gap" programs.

• Further Study Is Recommended

The Metcalf Subcommittee of the House Labor Committee, which has been studying proposed mine safety bills relating to metal mines, has recessed without taking action other than to recommend additional studies. The subcommittee did a fairly thorough job, but observers say there was certainly no eager-beaver attempt to cram the legislation through. If anything, the subcommittee seemed somewhat cool toward it.

• Protest Filed to Regulation A Changes

Opposition to the proposed change in the SEC Regulation A seems to be growing. Senator James E. Murray of Montana, chairman of the Senate Interior and Insular Affairs Committee, has lodged a strong protest with the commission against any action which would cut the flow of mine venture capital. He pointed out that the action of the Congress raising the exemption from $100,000 to $300,000 was sufficient evidence that the regulation at that time was satisfactory to the House and Senate. Any attempt to stiffen it, he said, would raise a storm of protest if small mine financing is cut off thereby.

• Malone's South American Report Released

Senator George Malone of Nevada has finally issued his long awaited South American report. It is Senate Document No. 83, 84th Congress, 1st Session. The foundation for this report was laid by an extensive trip made several years ago by Senator Malone and a group of experts and it has been in the process of preparation ever since. Although Malone no longer is chairman of the Interior Committee's Minerals Materials and Fuels Subcommittee, a special Senate resolution was obtained to permit publication of the extensive document under his name.

This book of over 600 pages contains an enormous amount of statistical data on the South American mining industry and its possibilities. In addition, it includes an estimate of the investment "climate" in each country, such as the possibility of private investments, Latin American tariffs, exchange controls and multiple-exchange, labor and wage rates, taxation, special incentives, investments guarantees, exports and imports, and distribution of income as well as comments on the mineral industry status in each country. There also are sections discussing European colonies and possessions in this hemisphere—British, French and the Netherlands. Altogether it is, within its framework, an encyclopedia of information well worth having, with much interesting and curious information never before gathered together in one volume.

Senator Malone and his staff are to be complimented on such a comprehensive job. The volume is well worth having and a copy or copies may be had free by writing for it to the Senator Interior and Insular Affairs Committee and asking for Senate Document No. 83, 84th Congress, 1st Session. A great deal of information on the trade of each country is presented in addition to mining data, so the book is of quite general interest.

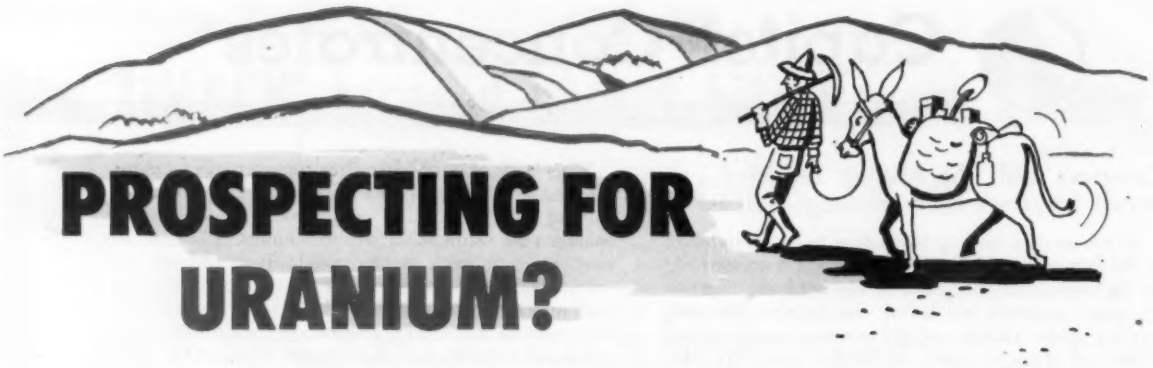
• Titanium Industry Reviewed in Staff Report

The staff of the Minerals, Materials and Fuels Subcommittee of the Senate Interior and Insular Affairs Committee has issued a second report on titanium, this one covering its advance among commercial metals in the year 1956. It is understood that a third report is scheduled for 1957.

The report, according to the foreword by Chairman James E. Murray, covers a "comprehensive survey" . . . "of the opinions of sponge producers, mill products producers, fabricators, and end users to determine their points of view," including "the adequacy of mill product production; whether the small available supply of titanium and the limited expansion program may be inhibiting use and incorporation in design; and the tendencies toward increased use."

The subcommittee staff draws the following conclusions:

1. It is now clear to the subcommittee staff that titanium is rapidly coming of age—perhaps more rapidly than was anticipated in the staff report of August 19, 1955.
2. The recent development of higher temperature resisant titanium alloys will increase its use in military aircraft.
3. The gradual reduction in price, if continued, will stimulate the use of titanium in Army, Navy, and commercial installations and equipment.
4. The extensive experimental programs instituted by the Armed Services and the Battelle Memorial Institute program are well designed to solve the working of titanium.
5. It appears that the staff report of August 19, 1955, was not over-optimistic as is indicated by the extensive expansion programs now underway without the use of government funds.



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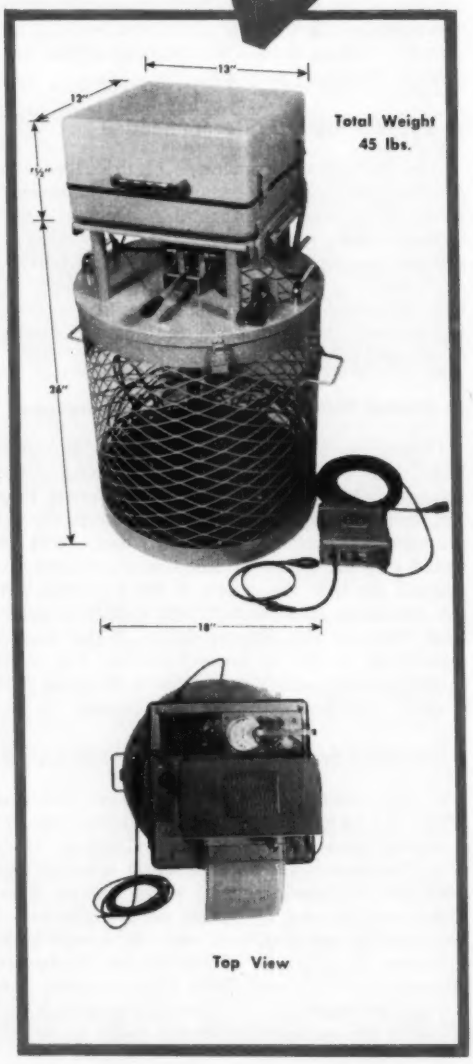

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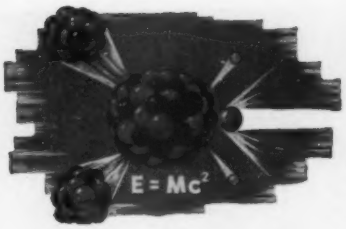

FISSION FACTS

Monthly Roundup of Mining News In the Atomic Energy Field

AEC Releases U_3O_8 Ore Reserves, Grade, and Mill Tonnages

Uranium mining and milling are big and important in the mining industry, and they are growing faster than any other segment of the industry; in fact, the dollar value of uranium concentrate produced in the United States in 1956 was greater than the value of lead produced and approached zinc value.

These are a few of the conclusions reached by MINING WORLD following release of "Statistics On Domestic Uranium Production and Oil Reserves" by the United States Atomic Energy Commission on December 13, 1956.

The January 1957 issue of MINING WORLD, which was on the printing press when the announcement was made, reported a mininum of 25,000,000 tons of uranium ore in the Ambrosia Lake, New Mexico district averaging five and a fraction pounds per ton of U_3O_8. This made Ambrosia a camp with a $1,000,000,000 potential. The release indicates, without question, that Ambrosia will be more than a $1,000,000,000 camp. On this basis ore value is over $40.00 per ton.

The AEC announced that production of U_3O_8 has already reached an annual rate of 8,000 tons or 16,000,000 pounds. This would have a minimum value of $128,000,000. We say "minimum" because the $8.00 published AEC price is used despite the fact that more than one mill received over $8.00 per pound for its 1956 output. Figuring actual 1956 output at 6,000 tons gives a value of $96,000,000.

When this was written in mid-January, final zinc and lead mine production during 1956 had not been released. Lead output is therefore estimated at 350,000 short tons, and zinc at 535,000. The *American Metal Market* has released the official average lead price during the year as 16.013 cents, New York, and 13.995 cents for zinc, East St. Louis. Lead production is then valued at about $112,000,000, and zinc approximates $149,900,000.

At the beginning if 1956, production was at the rate of about 4,000 tons U_3O_8 per year; in December 1956, the rate was more than 8,000 tons annually.

At the present time, there are 12 uranium mills in operation in the United States. A list of these plants and their capacities follows:

Company Name	*Location*	*Capacity Per Tons Ore/Day*
The Anaconda Company	Bluewater, New Mexico	3,000
Atomic Energy Commission	Monticello, Utah	600
Climax Uranium Company	Grand Junction, Colorado	350
Kerr McGee Oil Industries, Inc.	Shiprock, New Mexico	500
Mines Development, Inc.	Edgmont, South Dakota	300
Rare Metals Corporation	Tuba City, Arizona	250
Union Carbide Nuclear Co.	Uravan, Colorado	850
Union Carbide Nuclear Co.	Rifle, Colorado	280
Uranium Reduction Company	Moab, Utah	1,500
Vanadium Corporation of America	Durango, Colorado	430
Vanadium Corporation of America	Naturita, Colorado	350
Vitro Uranium Company	Salt Lake City, Utah	550
	Total	8,960

All of the above mills with the exception of the AEC-owned plant at Monticello, Utah, are privately-owned and operated.

It should be remembered that these are mill capacity figures and without question several of the mills have regularly operated at greater than their designed capacity so that total daily ore milled was probably 10 percent higher than designed mill capacity at year's end. This is proven by the mining rate given below as 1,660,000 tons in last 180 days of year. This is equivalent to 9,225 daily tons. Be sure to remember that Uranium Reduction was at full production for only a few tens of days.

The estimated investment in the privately owned mills now in operation aggregates $50,000,000.

During 1956, contracts involving the construction of nine new mills were negotiated. A list of these mills, which are scheduled for completion in 1957 or early 1958, follows:

Company Name	*Location*	*Rated Capacity Per Tons Ore/Day*
Atomic Fuels Extraction Co.	Bedrock, Colorado	200
Dawn Mining Company	Ford, Washington	400
Gunnison Mining Company	Gunnison, Colorado	200
Lost Creek Oil & Uranium Co.	Split Rock, Wyoming	400
Lucky Mc Uranium Corporation	Fremont County, Wyoming	750
Trace Elements Corporation	Maybell, Colorado	300
Texas Zinc Minerals Company	Mexican Hat, Utah	775
Union Carbide Nuclear Company	Rifle, Colorado	1000*
Homestake New Mexico Partners	Grants, New Mexico	750
	Total	4,775

*Including ore fed to concentrating plants.

The following additional milling contracts are believed to be under negotiation with contract approval scheduled for early this year:

Company Name	*Location*	*Capacity Tons Ore Per Day*
Homestake-Sabre-Pinon Partners	Grants, New Mexico	1,500
Philipps Petroleum Company	Grants, New Mexico	750
Kermac Nuclear Fuels Company	Grants, New Mexico	1,500
	Total	3,750

Both Climax Uranium Company and Calumet and Hecla, Inc. have developed substantial ore reserves in New Mexico and mill capacity will be needed if this ore is to be mined.

Uranium ore production in the United States since June 30, 1955, was as following according to the AEC: July-December (1955), 840,000 dry tons of ore. For 1956, January-June, 1,340,000; July-December, 1,660,000. The total for 1956 was 3,000,000. The last quarter of 1956 is estimated.

As of November 1, 1956, domestic ore reserves, by areas, were estimated as follows by the AEC:

	Measured, Indicated and Inferred Ore		
Area	*Tons*	*% U_3O_8*	*% of Total Ore*
New Mexico	41,000,000	0.24	68.4
Utah	7,500,000	0.34	12.5
Colorado	4,100,000	0.33	6.8
Arizona	2,600,000	0.30	4.3
Wyoming	2,300,000	0.22	3.8
Washington	1,500,000	0.18	2.5
Others	1,000,000	0.24	1.7
Total	60,000,000	0.25	100.0

The New Mexico reserves are larger than those estimated by MINING WORLD in its January 1957 issue. However, the grade is less than 0.02 different. The 41,000,000 tons might be broken down as 30,000,000 tons Ambrosia Lake, 10,000,000 Laguna-Jackpile, and 1,000,000 Haystack-Poison Canyon.

Utah reserves which include the Big Indian, Hidden Splendor, and Happy Jack district and mines are smaller than many industry observers believed.

There is no indication of how much of Colorado's reserves include the large but very low-grade deposits developed by Trace Element Corporation in Moffat County. If included in the 0.33 grade, Morrison ores from Uravan Mineral Belt must be considerably higher than average grade.

Arizona reserves and grade surprised many. This ore must nearly all be on the Navajo Reservation and assures long time operations for mills treating this ore.

Many consider the Wyoming reserves as conservative. The same applies for Washington where larger reserves of much lower grade have been developed. There is no indication that the AEC has included such reserves, which are the subject of much upgrading study, as part of the mineable researve.

What about use of all this uranium? That is the big question and it has the best brains in the AEC and private industry sharpening their pencils.

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The Right Pick is important. That applies to choice of trailing cords and cables, too. Be guided by the fact that veteran mine-men prefer TIREX. This expertly engineered cable, newly improved for greater flexibility, has cured-in-lead Neoprene Armor that resists abrasion, oil, heat and water . . . gives maximum wear.

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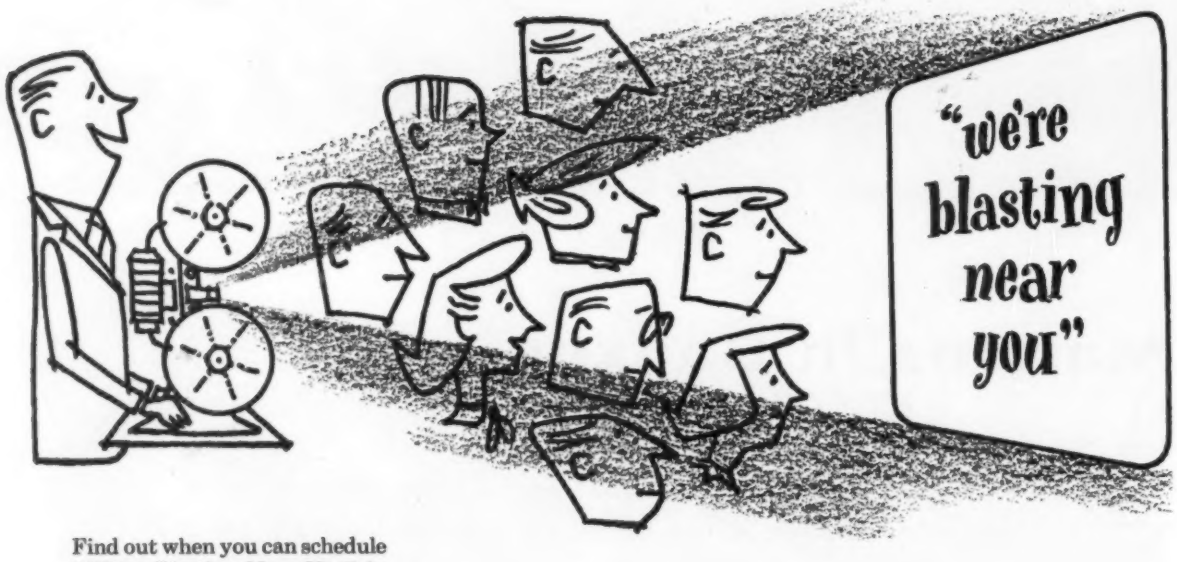
"*We're Blasting Near You*" can be shown to any age group: schools, service clubs, civic organizations. It is accompanied by a kit which includes suggested news releases, a sample introductory speech for the person presenting it as well as safety posters, and other helpful material. Show this unique new movie in your area. It can be an important help to you.

New film...

builds goodwill for users of explosives



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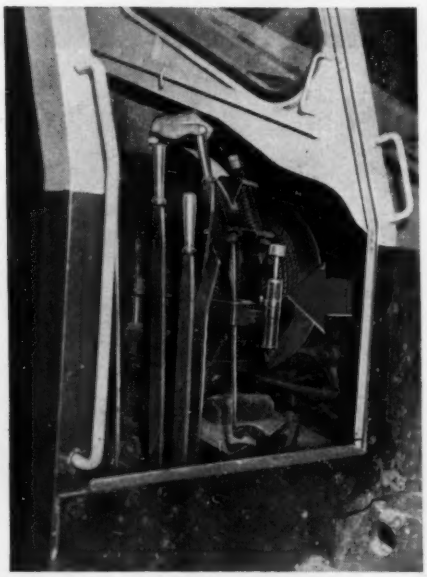
The Engineer's Report

CASE HISTORY

PRODUCT Chevron Starting Fluid

FIRM Larry Hendricks Construction Co., Mt. Vernon, Wash.

Special fluid starts shovel in seconds saves manpower, batteries in cold weather



PIPE LINES, ROAD CONSTRUCTION and general contracting jobs keep this ¾ yd. Bucyrus-Erie shovel working hard the year 'round. The Larry Hendricks Construction Co. uses 7-cc. gelatin capsules of Chevron Starting Fluid to get the rig's GM-371 powerplant into action fast in cold weather. Owner Hendricks says, "This shovel makes money only when it's working. I can't afford to waste man-hours or wear down batteries getting it started. With Chevron Starting Fluid one man puts it on the job in a few seconds, even in coldest weather. We like the capsules, too. They deliver a safe, controlled charge. Too much fluid makes an engine race, and that ruins bearings quick." Capsules are discharged through manual applicator installed in cab of excavator. (See arrow, right.) Chevron Starting Fluid atomizes at temperatures as low as -65° F. Fires under pressure or weakest engine spark.

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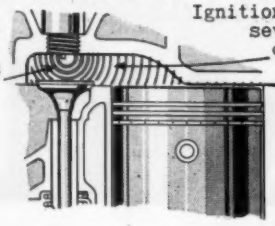

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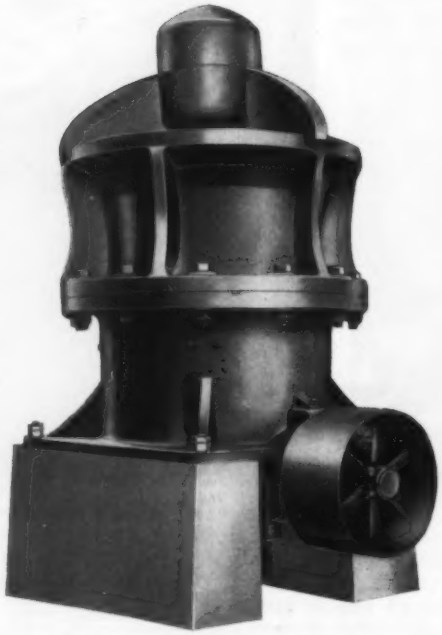

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Traylor Reduction Crushers are famous throughout the industry for the extra *production* and extra *profits* they put into mining operations. Traylor-made in ten sizes, with feed openings from 1½" to 22", Traylor Reduction Crushers provide capacities up to 590 tons per hour. For complete specifications write for Traylor Bulletin No. 11-120.

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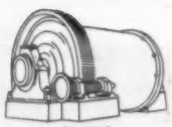
BALL MILLS

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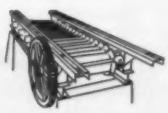
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Good fumes and fast loading "sell" Kansas mine on Du Pont "Extra" C

Easy-to-handle 16" cartridge

You're in the Little Ben Mining Co.'s Clark mine, Baxter Springs, Kansas. Now, crewmen are tamping Du Pont "Extra" C into boreholes. Another shot on the way.

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Eleven International "95" PAYHAULER units...because of their high speed, big pay-capacity and around-the-clock endurance...are playing the starring roles in the St. Lawrence Seaway's biggest, and probably toughest, single show!

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PAYHAULER units also loaded out most of the rock for fill from cuts made on a lower Beauharnois lock. On a similar shorter-haul rock job in the midwest recently, two identical PAYHAULER units maintained a production average of 2,400 cu yds per day! And here on the seaway, with average 4,000-foot one-way hauls, PAYHAULER units high speed, next-to-automatic Torqmatic brake control, and minute-saving, easy-to-heap big capacity are cutting cycle time to a minimum—and delivering maximum loads.

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Most ore mined by the world-famed Anaconda Company at Butte, Montana, is smelted by the Anaconda Reduction Works in nearby Anaconda. From a pioneer beginning, nearly 75 years ago, this smelter has grown to be one of the largest in the world. This growth reflects Anaconda's unceasing search for a *better* way at *lower* cost in *less* time. Typical was their recent shift from slow single-purpose handling equipment to two highly mobile Michigan Tractor Shovels.

Transports material weighing 5,400 lbs per cu yd

These rugged versatile 2¾ yard Model 175A's "run" at 27 mph speeds all around the big plant to handle a wide variety of loading tasks. Hard-to-handle chunks of ferro-manganese—*weighing 200 pounds per cubic foot* —are the heaviest tractor-shovel work on hand.

One of the Michigans usually does the entire job. In a few hours it moves weekly requirements of 100 tons 750 feet from plant stockpile to massive timber storage platform. Planetary wheel drive axles, torque converter take up shocks of this rugged work.

Outworks a crane— with half the manpower

Planetary axles and the efficient all-Clark power train help out on another tough job—truck-loading "purification cake"—a sludge from the smelting process, rich in metals such as gold and silver. With a crane, it used to take 12 hours (and a 2-man crew) to load 240 tons; one Michigan now does the *same* job in *six* hours—with only one man! Operators like the fast reverse and power-shifting of the Michigan . . . management is pleased with the time and labor saved.

Goes in to load where trucks don't dare

Millions of cubic feet of calcine—iron oxide powder —are stockpiled here; it's used to make sponge iron for

treating copper ore in the flotation process. But on the ground it's a mountain of soft, treacherous dust. Trucks sink deep into the soft footing, so the big-tire four-wheel-drive Michigans go in alone, rush heaping buckets back out. A single Michigan keeps three five-yard trucks busy on a half-mile haul, heaps up to 80 truck loads in a day!

Spots and loads 12 rail cars in 5 hours

Anaconda's two Michigan 175A's spend roughly 30% of their time loading stockpiled crushed limestone. They move empty rail cars into position at the quarry, then fill them up. Loads run about 60 tons per car; each Michigan can fill a dozen cars in only five hours! Off-time jobs include stripping dirt; cleaning haul roads and around conveyors; helping trucks up steep grades; and removing tons of ash from the flue of the smelter stack.

In 8 hours, digs 80 foot trench through rocky soil

Despite busy schedules moving various stockpiled materials, the Michigans find time to do lots of odd jobs, too. Here, a Michigan digs its way through sun-baked earth and rock, excavating the trench for a concrete tunnel to hold electrical conduit. The trench is eight feet deep, ten feet wide, 80 feet long. How long did it take? *Only one 8-hour day*—and this includes piling waste material 100 feet away! The secret is a *full bucket* loaded and delivered every pass, a "trademark" of all Michigans. Unexcelled breakout force, low-level-tipback and low-level-carry also help deliver those bigger loads.

Which of these will fill the bill for you?

Model 12B:
6, 10, 16 (std), 20 or 27 cubic *foot* buckets
Models 75A, 75B, 75R:
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Model 375A:
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For help in determining which of these eight models and how many of their 37 different buckets and attachments, will do an Anaconda-class job for you, let one of our Job Study Engineers study your layout. A card or a call will bring him. No obligation, of course—but we believe you'll find his suggestions worth further study!

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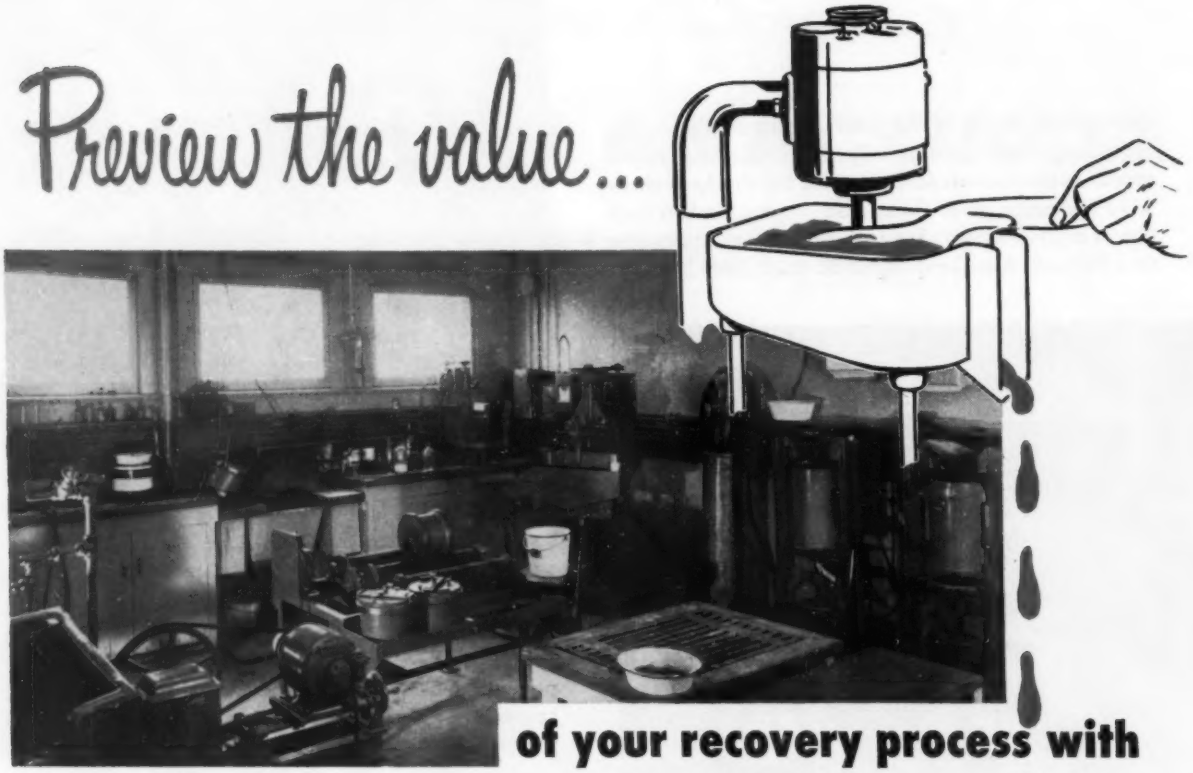

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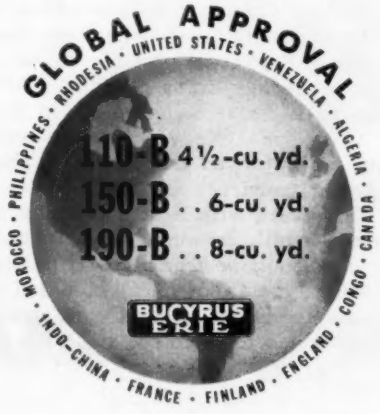
Bucyrus-Erie 6-yd. 150-B shovel working at Eagle Mountain mine. Ore bearing formations here are high in iron content and considerably heavier than most rock.

Miners the world over have learned to expect outstanding performance from Bucyrus-Erie Ward Leonard electric shovels — and they get it, no matter how tough the assignment.

The machine above, for instance, is on a California project where it handles massive, heavy iron ore and waste rock — an extremely hard, fine rock which is quite abrasive. It's a true test of an excavator's strength and durability but here, as on other tough jobs the world over, the Bucyrus-Erie shovel moves big yardages economically — day after day, month after month.

It's the *extra margin of quality*, both in design and manufacture, that qualifies Bucyrus-Erie Ward Leonard electric shovels for world-wide acceptance — and lets them live up to it. We would like the opportunity of explaining that extra margin of quality — and what it can mean in performance on your job. 96L56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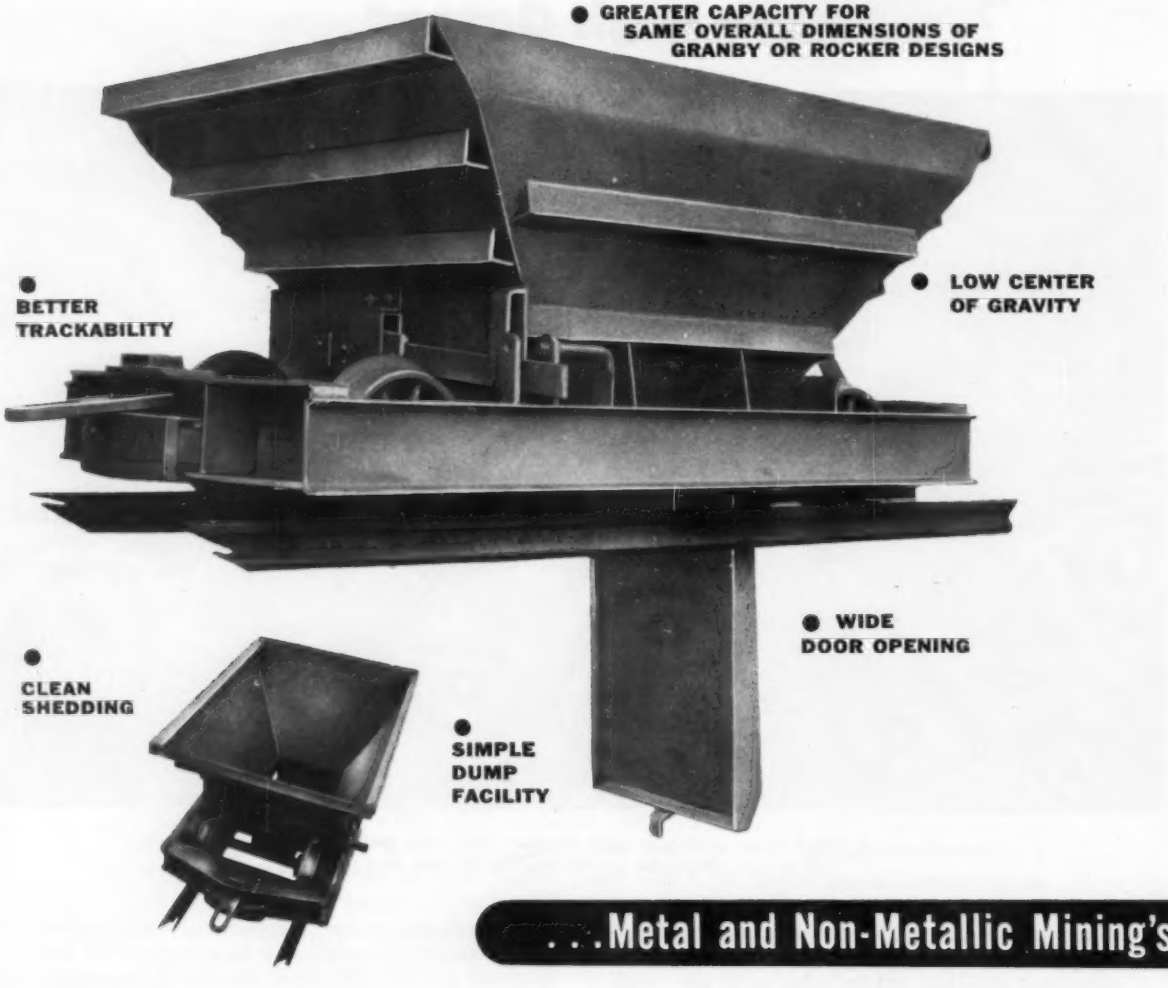
Another New Mine Car Development from Sanford-Day. . .

S-D "ONE-DOOR" BOTTOM DUMPING CAR OFFERS INDUSTRY MANY ADVANTAGES . . .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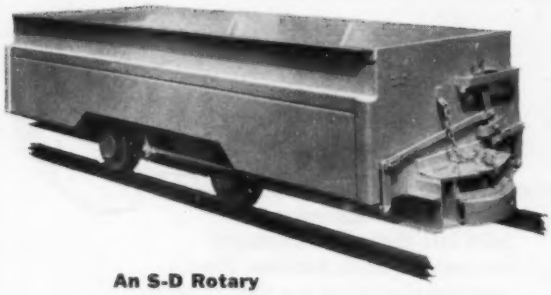
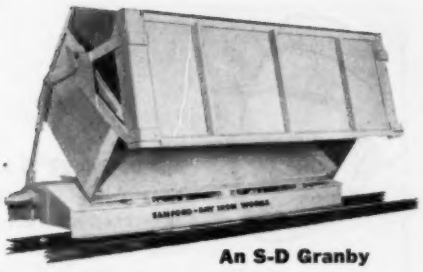
● SIMPLE DUMP FACILITY

. . . Metal and Non-Metallic Mining's

● **AND RUGGEDNESS OF DESIGN!** This new one-door bottom dumping designs offers greater cubic foot capacity for the same overall dimensions than has been possible to obtain in granby or rocker dump designs. Also, we have a much better balanced car in this new S-D "One-Door" Car with a low center of gravity for improved trackability. This outside frame construction also permits us to build these cars with a door opening that is maximum width between bottom flanges of rails. Also, outside frame construction lends itself well to the use of spring mounted trucks, which may be added to meet your specific requirements. Note there are no inside gussets or stiffeners on inside of car body or materials side of specially designed door to retard clean shedding of materials. This feature has particularly impressed users. On this car flares are on 60 degree. Cars are designed and built to meet the requirements of loading by overshot loader or chutes. This new car is also submerged arc welded for parent metal strength as are all Sanford-Day mine cars! Also, overall length may be increased. Let us analyze your problem and supply you with this car in the proper flare design to meet the shedding requirements of your material. *Manufactured exclusively by Sanford-Day, Knoxville, Tenn.*



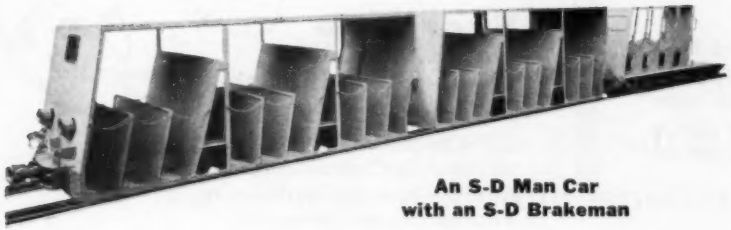
An S-D Rotary



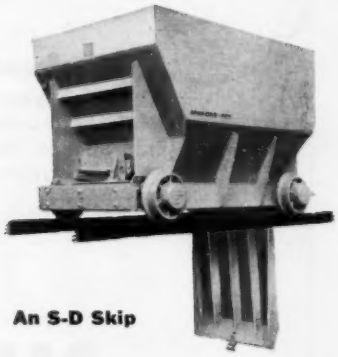
An S-D Granby

An S-D Automatic with
Spring-Mounted Trucks

An S-D Rocker

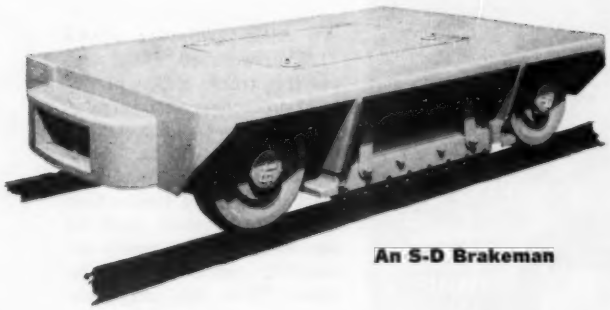


An S-D Man Car
with an S-D Brakeman



An S-D Skip

Super Market for Mine Cars



An S-D Brakeman

An S-D Gable Bottom

Sanford-Day Iron Works, Inc., Knoxville, Tenn.

SANFORD-DAY

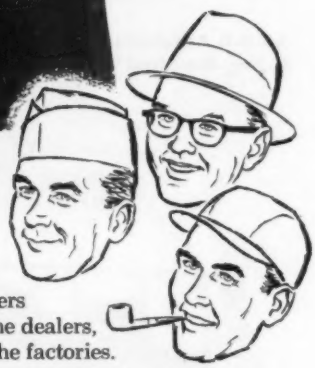
AD 6095

Owners know that every Allis-Chalmers engine is backed by the company's long reputation for building engines that are *tops* in dependability and economy — engines totaling hundreds of thousands of horsepower.

Operators like the continuous-duty rugged power, the reserve built into their Allis-Chalmers engines. As loads increase, these high-torque engines lug right through.

They ALL Like Allis-Chalmers Engines . . .

Mechanics find there are less parts — that they are simple, easily accessible, require fewer adjustments. Maintenance time is reduced to a minimum.



Everyone likes the Allis-Chalmers *3-deep* service from the dealers, the 18 branches and the factories.

For more reasons why "they all like Allis-Chalmers engines," see your Allis-Chalmers engine dealer, or write for detailed information.

ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

BE-10A

An Allis-Chalmers 8DAS 1125 supercharged diesel powers this truck, and a 6DCS-1879 supercharged diesel powers the shovel at the Bagdad Copper Corp. mine. Allis-Chalmers diesel engines in 24 Dart and Euclid trucks help keep production flowing smoothly under extremely demanding conditions at the mine. These big, tough engines also are used here on drills, compressors and dozers.

Congratulations

Union Miniere du Haut-Katanga

on your

50th Anniversary

We are particularly proud that you selected Lectromelt equipment for your melting and smelting operations.

For information on Lectromelt furnaces and equipment, write Lectromelt Furnace Company, 324 32nd Street, Pittsburgh 30, Pennsylvania (a McGraw Edison Company division).

Lectromelt

*REGISTERED TRADEMARK U. S. PAT. OFF.

dig modern . . . cut tonnage

P&H

ELECTRIC SHOVELS

featuring MAGNETORQUE* and ELECTRONIC CONTROL

costs with

In open pit mining throughout the world there is good reason for the cost cutting record of P&H Electric Shovels. Magnetorque plus P&H Electronic Control give smooth, effortless operation—faster dipper action —heavier bail pull.

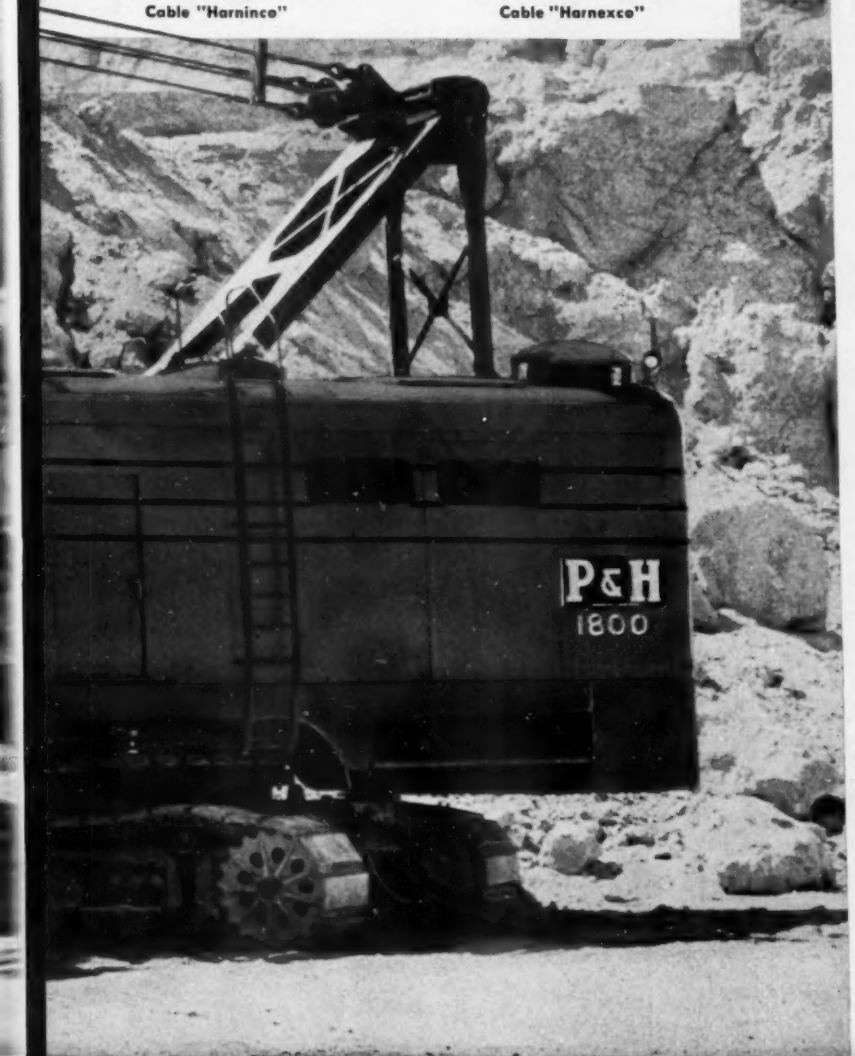
P&H Electric Shovels offer many other advantages that mean greater availability and lower maintenance cost especially under severe conditions. With P&H you get all-welded strength, simplicity of design and proved on-the-job dependability. P&H Electric Shovels range from 3½ to 8 cu. yds. in capacity.

Worldwide demand for P&H equipment makes it wise to anticipate your *future* needs *today*. It will pay you to contact your P&H dealer soon.

T.M. of Harnischfeger Corporation for electro-magnetic type coupling.

HARNISCHFEGER INTERNATIONAL CORPORATION, S. A.
Milwaukee 46, Wis., U.S.A.
Cable "Harninco"

HARNISCHFEGER EXPORT CORPORATION
Milwaukee 46, Wis., U.S.A.
Cable "Harnexco"



P&H

is happy
to join the
Anniversary
Salute to . . .

UNION MINIERE DU HAUT-KATANGA

Congratulations on 50 Years of Progress and Achievement

and

Best Wishes for Continued Growth

Here's why more and more overburden is being handled with Planet-Power steered INTERNATIONAL® TD-24 crawlers!

See for yourself how a TD-24 can boost your operating profits! Compare seconds-fast, all-weather TD-24 gasoline conversion diesel starting—to slow methods that pile up costly delays. Note how Cerametallic engine clutch action reduces operating effort, gives top *power-transfer efficiency!* Measure TD-24 power-weight-traction balance against any other machine in any kind of footing. See what exclusive TD-24 Planet-Power steering does to increase *payload* and *job-speed.*

At the same time, prove the excavating and loading capacity, and *versatility unlimited,* of an International Drott Four-In-One Skid-Shovel. See your International Construction Equipment Distributor for a demonstration.

"Major reasons: capacity and service"

—Byron Construction Co., Clarksburg, W. Va.

This coal field contractor uses five TD-24's to clear right-of-way, build roads and strip overburden on a large bituminous coal-stripping operation near Lost Creek. The TD-24's remove an average depth of 90 feet of slate, limestone, sand, and earth overburden—to uncover 5-foot Pittsburgh and 8-foot Redstone, seams.

Four of the TD-24's are new, replacing four competitive crawler-dozer units. The other TD-24 in the fleet has done 7,500 hours of heavy, crawler-mauling coal field work—since '52!

"Work capacity and distributor service were major reasons for buying the four new TD-24's," reports Tony Petitto, Jr., for Byron Construction Company! ...Photo shows two of their new TD-24's—leveling spoil-bank so a dragline can "walk" to new location.

INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Side-Boom Tractors... Self-Propelled Scrapers and Bottom-Dumps... Crawler and Rubber-Tired Loaders... Off-Highway Trucks... Diesel and Carbureted Engines... Motor Trucks.

"TD-24's do more work, faster"

—Buckeye Coal Co., Hanging Rock, Ohio

On the extensive Buckeye Coal Company operation, near Ironton, Ohio, two large draglines, and two International TD-24's strip overburden 40 feet deep from the 40-inch "Ohio No. 5" seam. The operation produces 1,000 tons of steam coal daily.

"Our TD-24's do more work, faster, than other large crawlers we've had on the strip," states C. E. Collins, Buckeye Coal Company partner. "This performance explains our *repeat* buying. We replaced one TD-24 with a new one, added another new one, and have a third one on order."

Exclusive International Planet-Power steering gives you full-time "live" power on both tracks—to turn *under positive control*, pulling or pushing big payloads!

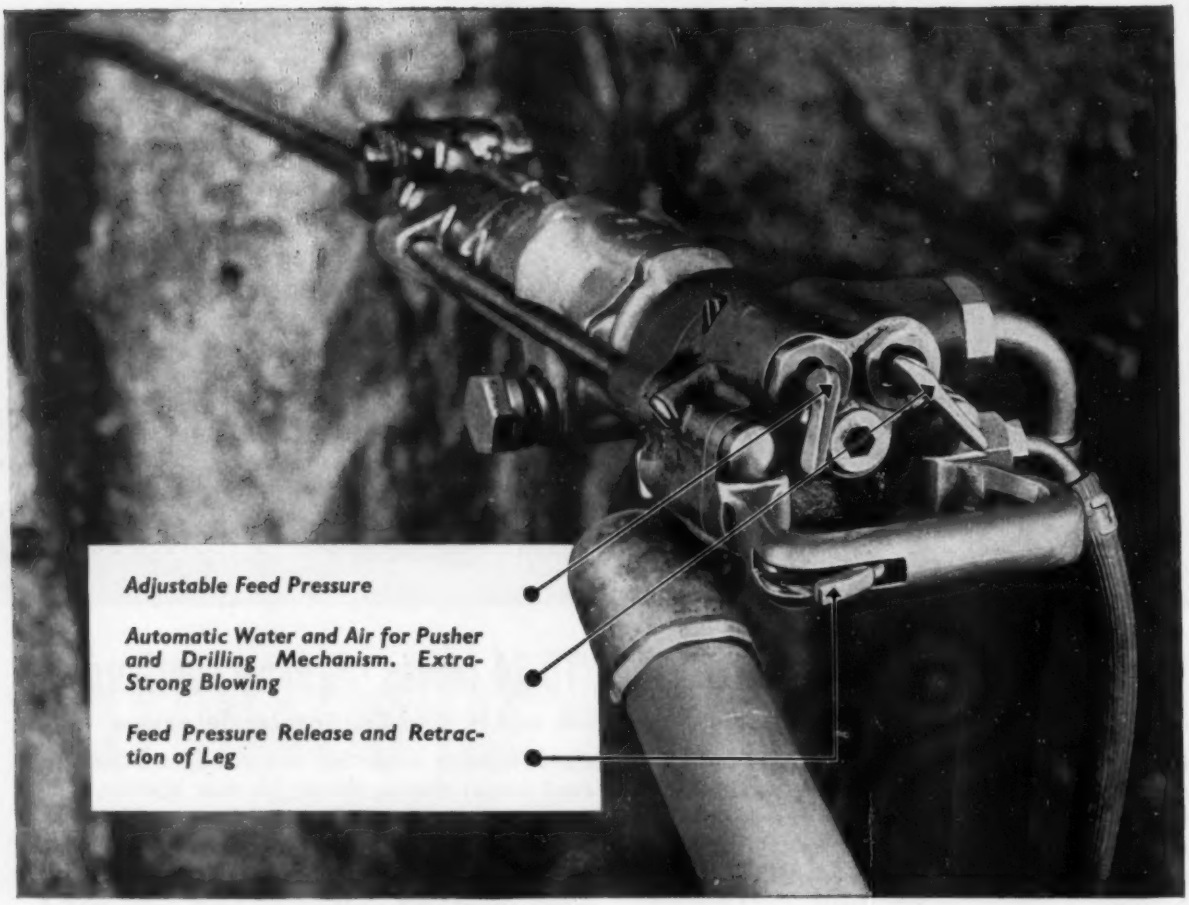
"TD-24 moves 1/3 more overburden"

—B. and H. Coal Co., Spencer, Tennessee

Bonus capacity is the key reason why a TD-24 got (and keeps) this big dozing job near Spencer, Tennessee. Up to 35 feet of overburden are stripped to uncover the 4-to-8-foot "Swanee" seam.

The TD-24 with hydraulic tilt dozer, and a large power shovel team up on the stripping—to provide a profitable combination.

"Our TD-24 dozer is moving up to one-third more overburden daily, than previous large tractors," reports B. and H. Company partner, C. L. Brock. "This increase results from greater weight (for full-power traction), full-time power on both tracks while steering, and tilting blade to speed digging in hard materials."


Adjustable Feed Pressure
Automatic Water and Air for Pusher and Drilling Mechanism. Extra-Strong Blowing
Feed Pressure Release and Retraction of Leg

RETRACTABLE LEG AND ONE-HAND GRIP-CONTROLS SPEED DRILLING TIME

For years Atlas Copco have been the world's largest manufacturers of pusher leg drills. Since 1937 when Atlas Copco, far ahead of any other manufacturer, introduced their first pusher leg drills, they have continuously improved the design of these drills. Their latest development, the Atlas Copco 'Lion', combines an unequalled ease of operation together with a high drilling rate—both contributing to a higher footage per manshift.

All controls under one hand

The Atlas Copco Lion is the first drill to have all the valves which operate the drill under the control of one hand. *Full control without having to move the hand from the backhead!*

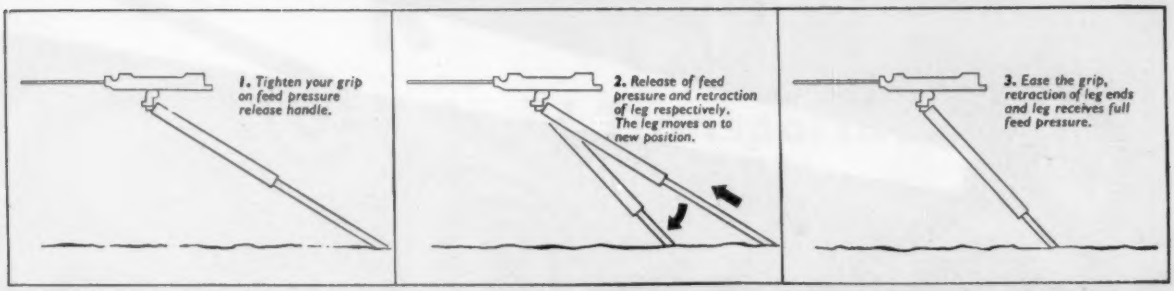
The valves are all easy to operate. By the use of only the fingertips the drill can be started or shut off, the feed can be adjusted to the pressure required, or retracted for an advance, and the extra air-blowing can be brought on to clean the holes.

All the control handles have been designed in such a way that they are well protected. While using them the operator's hand is never near the wall or roof of the drift. The Lion is the first pusher leg drill with controls placed for drifting.

Retractable leg saves time

When the leg has to be moved the feed pressure is easily released by squeezing the hand grip. By further pressure on the grip the leg retracts automatically.

Pusher leg moves forward with drill in full action


1. Tighten your grip on feed pressure release handle.
2. Release of feed pressure and retraction of leg respectively. The leg moves on to new position.
3. Ease the grip, retraction of leg ends and leg receives full feed pressure.

When the leg is in the new position suitable for continuous drilling, retraction stops and the feed pressure comes back by loosening the grip of the hand. *All this can be done while the drill is still running.*

This new idea of a retractable leg enables quicker repositioning of the leg and reduces the number of steel changes, thereby increasing footage per manshift. When drilling high holes it is now far easier to alter the position of the leg more frequently in order to maintain an optimal feed angle and feed pressure.

Packed with power for deep holes

The Lion has a drilling rate at least 30% higher than other rock drills of the same weight. Furthermore, it is designed so that it can maintain its high speed *even when drilling deep holes.* This means quickly drilled deep hole rounds and a faster, steadier advance. You'll also find that the Lion reduces *to a minimum* the gauge wear of the bits in abrasive rock. And owing to the ease with which the feed pressure is released and brought back into action, the Lion is a *handier* drill to work with in fissured rock.

Sandvik Coromant—the right steel for the Lion

All Atlas Copco drills—and this goes for the Lion—have been developed from the earliest stages with Sandvik Coromant tungsten-carbide-tipped integral steels and detachable bits. No drill or steel developed separately could ever give such equivalently high performances as this drilling combination. It is today the most widely used in the world, responsible for drilling more than one billion feet per year.

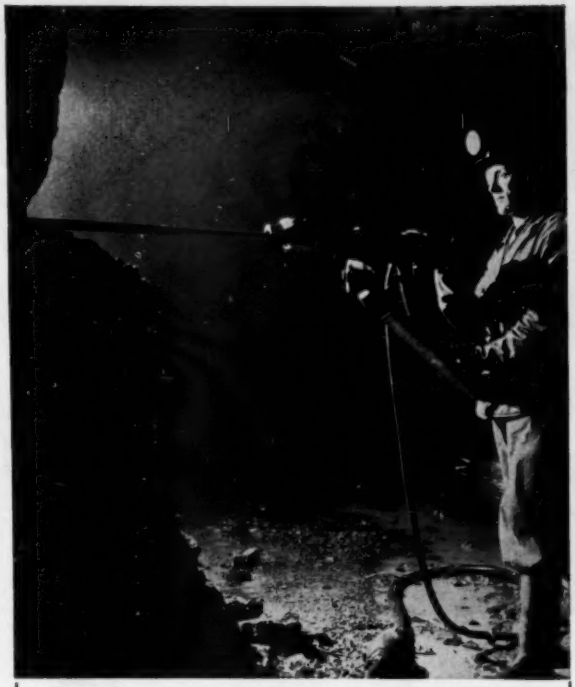
Free Demonstration! *Wire, 'phone or write* today *to any one of these offices and see the Atlas Copco Lion in action for yourself.*

U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern, Inc, P.O. Box 2568, Paterson 25, N.J.

CANADA, Atlas Copco Canada Ltd., Montreal Airport, P.Q.

MEXICO, Atlas Copco Mexicana S.A., Apartado 56, Torreon, Coahuila.

The ATLAS COPCO GROUP puts compressed air to work for the world. It is the largest group of companies specializing solely in the development and manufacture of compressed air equipment. It embraces Atlas Copco companies or agents manufacturing or selling and servicing Atlas Copco equipment in ninety countries throughout the world.



Without changing the grip of the hand the driller can easily position and control the machine, saving time and reducing fatigue.

Atlas Copco DS51

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

Man-hour protection for working crews . . . the Edison R-4 double-filament bulb

Working crews are assured greater underground safety, more productive man-hours because the Edison R-4 double-filament bulb is on the job.

Miners equipped with this bulb know that burn-out doesn't mean blackout. If one filament burns out, a turn of the switch transfers the power of the unfailing Edison battery to the second filament—continued, brilliant illumination is restored for the full shift. There's no lost time for the miner, or short crews for the foreman. There is only *one bulb*, located in the center of the headpiece, which gives the advantages of maximum reflector area.

This kind of reserve light protection means that hundreds of man-hours may be saved every year. The result is increased production with an added margin of safety. Our bulletin gives complete details. Write for your copy.

Edison R-4 Cap Lamp . . . ideal for self-service systems.

MSA
SAFETY EQUIPMENT HEADQUARTERS

When you have a safety problem, M-S-A is at your service . . . our job is to help you

MINE SAFETY APPLIANCES COMPANY
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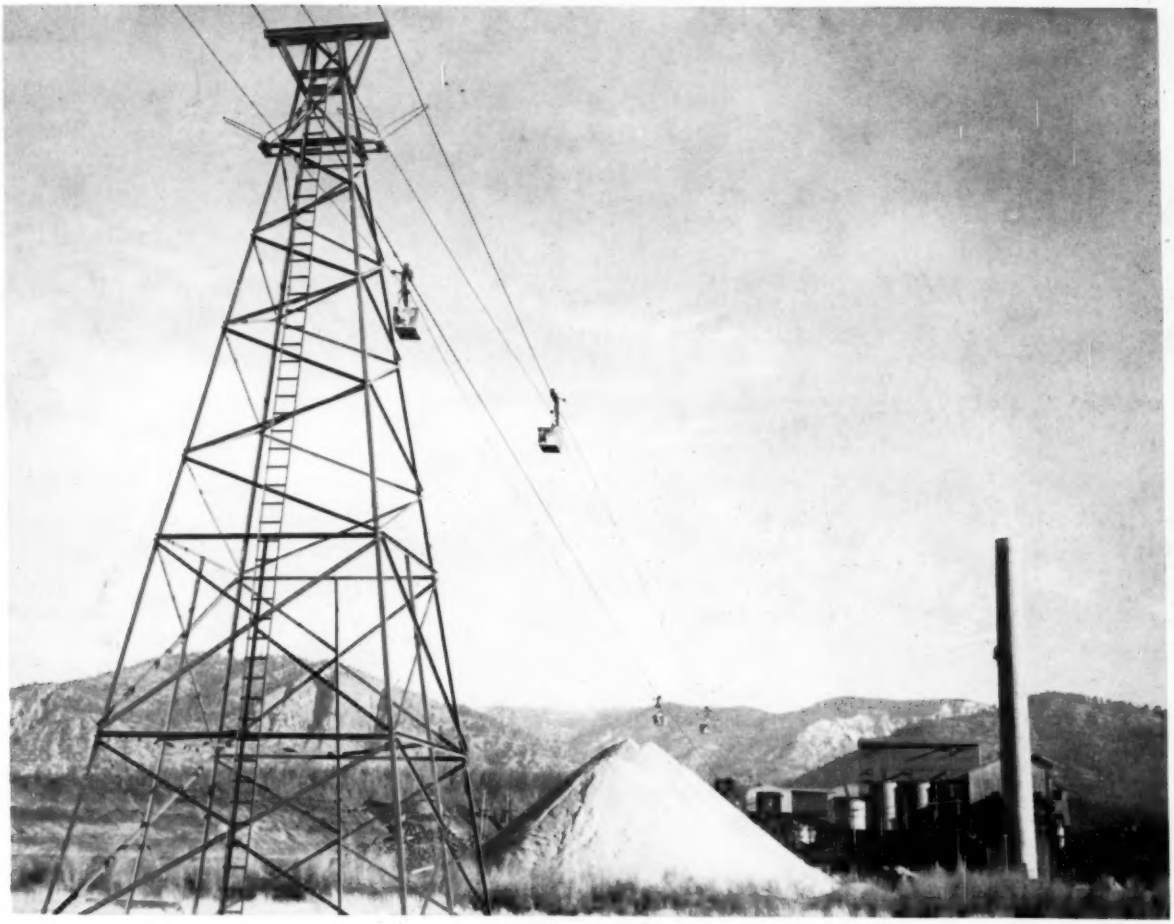
At Your Service: 77 Branch Offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.

R T C

Stands for Reduced Transportation Costs AND Riblet Tramway Co.



Whether you are transporting bauxite in Jamaica, uranium ore in Colorado or pineapples in Hawaii, there's an Automatic Riblet Tramway that will reduce your costs. Recently developed automatic equipment reduces labor and increases efficiency. Let us give you an estimate for revising your transportation problem with a Riblet Aerial Tramway.

WRITE FOR OUR AERIAL TRAMWAY BROCHURE

RIBLET TRAMWAY CO.

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SPOKANE, WASHINGTON, U.S.A.

Designers, engineers, manufacturers and erectors of Aerial Tramways since 1897.

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JIRON CARABAYA 631 - Of. 812
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E.E.U.U.
CHAMONIX-MONT

Morning Mail...

from the wide, wide World

Each day from satisfied Cyanamid customers, from consulting engineers and laboratories, from engineering schools, from prospectors, mill men and general managers, from all sorts of people and companies interested in the mining business come dozens of letters bearing foreign postmarks. They seek product information or advice on milling problems. They report on unusually successful applications of Cyanamid metallurgical chemicals, and many of them contain repeat orders for Cyanamid products.

It is indeed gratifying to find daily evidence in the mail that our continuing efforts to serve the mining industry are well known and respected the world over.

CYANAMID

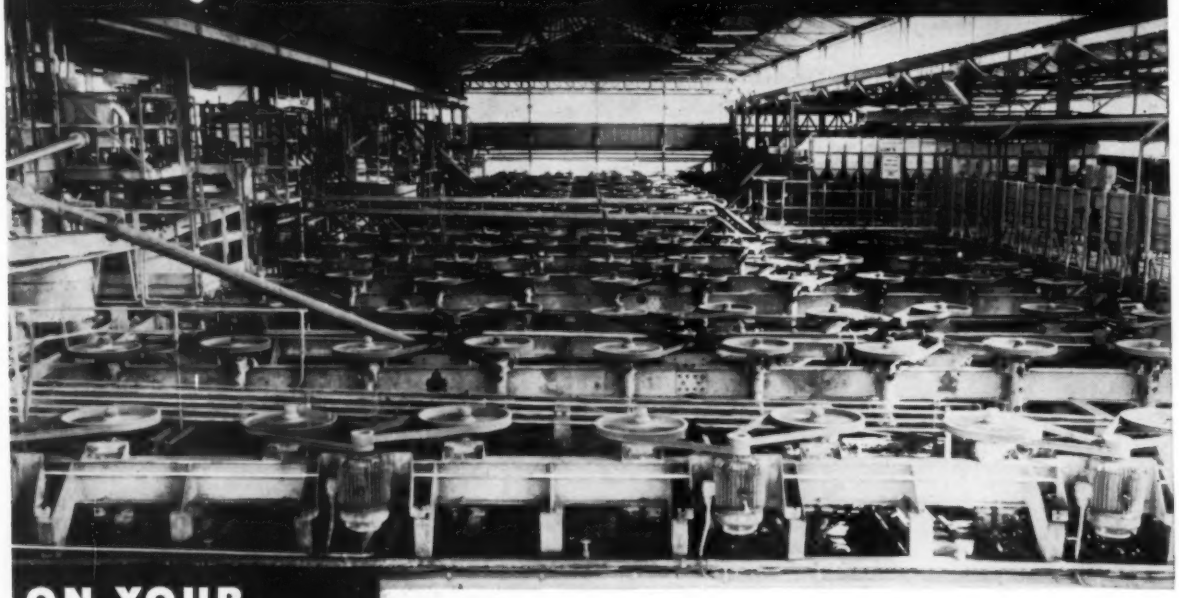
AMERICAN CYANAMID COMPANY

MINERAL DRESSING DEPARTMENT

30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK

1907 1957

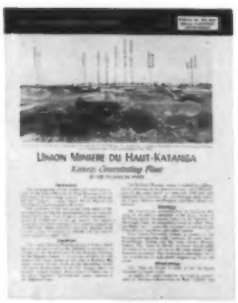
Congratulations U.M.H.K.*



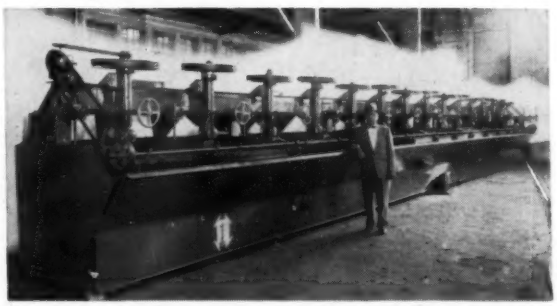
ON YOUR 50TH ANNIVERSARY

*UNION MINIERE du HAUT-KATANGA

We of the Denver Equipment Company are proud to congratulate the Union Miniere du Haut-Katanga on their 50th Anniversary! We are also proud of the part Denver "Sub-A" Flotation has played in the fabulous growth of this great organization! Since 1939, U.M.H.K. has steadily increased the number of cells to where, today, they have over 870 Denver "Sub-A" cells in operation! Again...congratulations, U.M.H.K....may the next half-century see even more phenomenal growth!



For your engineering notebook
Union Miniere Du Haut-Katanga's Kolwazi Concentrating Plant was featured in the Nov.-Dec.'52 DECO Trefoil. Copies are available on request.



Here is the latest 14 cell Denver "Sub-A" Flotation machine at Deco factory prior to shipment to U.M.H.K.'s Belgian Congo operations.

"The firm that makes its friends happier, healthier and wealthier"

DECO ENGINEER — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

DENVER EQUIPMENT CO.

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Mining World

THE IMPORTANT MINING MAGAZINE EVERYWHERE

February 1957

INTERNATIONAL PANORAMA

KASONSO, FEDERATION OF RHODESIA AND NYASALAND—The New Discovery Corporation with financial help from American Smelting and Refining Company has increased its diamond drilling program in search of copper sulphides. Oxide mineralization is extensive in the area 190 miles northwest of Lusaka.

SAN FRANCISCO, CALIFORNIA—Production of refined zinc in the United States in 1956 was at an all-time yearly high of 1,062,954 short tons. In 1955 output was 1,031,018. United States government took 157,014 tons of the 1956 production.

NEW YORK—Kennecott Copper Corporation, world's largest copper producer, is getting into titanium in a big way. Already a major ilmenite producer, Kennecott has joined Allied Chemical and Dye Corporation to build a plant to produce titanium tetrachloride, titanium soonge, and titanium billets. Kennecott's brass subsidiary will roll and fabricate titanium shapes.

DUBLIN, ERIE—Can-Erin Mines Limited is planning an underground mine development program at its Mountain Mine copper property here following successful surface diamond drilling.

LIMA, PERU—M. Hochschild & Company, Ltd. is installing two 100-ton-per-day mills at its Condoroma lead-zinc-silver mine in Espinar Province at an altitude of over 16,000 feet.

GEORGETOWN, BRITISH GUIANA—Aluminium Ltd. is building a new alumina plant to refine 500,000 annual tons of bauxite into 250,000 tons of alumina. Bauxite will come from Aluminium's mines on the Demerara River.

TWO HARBORS, MINNESOTA—Final shipment of Mesabi Range iron ore for 1956 was made here on 19 December. This is the latest closing date in history for the Great Lakes ore shipping season. Total Lake shipments were 77,633,027 gross tons in 1956, down from 87,459,853 in 1955.

TORONTO, CANADA—LeMoyne Ungava Mines Ltd. has made a high-grade nickel discovery in a zone between Hudson Bay and Ungava Bay in northern Quebec.

HELSINKI, FINLAND—A promising copper deposit has been found at Suonenjoki in central Finland. M neralization is at least four kilometers long and up to several hundreds of meters wide.

BURSA, TURKEY—A new company, Turk Molibden Serketi, has been formed to build a molybdenum flotation mill to treat 500,000 tons of 0.40 percent Mo ore.

GRAND JUNCTION, COLORADO—Minerals Engineering Company, large tungsten producer in Montana and Mexico, is planning a 400-ton-per-day vanadium mill in the Federation of Rhodesia and Nyasaland.

MELBOURNE, AUSTRALIA—Consolidated Zinc Corporation, Ltd. has formed a new company—Commonwealth Aluminium Corporation Pty. Ltd.—to develop bauxite deposits on the west coast of Cape York Peninsula.

BUTTE, MONTANA—The Anaconda Company plans to increase copper output of its United States mines 44.5 percent by 1961. Production in 1955 was 124,016 tons.

OTTAWA, CANADA—Canadian mineral production reached an all-time high value of $2,067,699,096 in 1956. Oil led in value, followed by copper, nickel, iron, and gold.

TEXAS CITY, TEXAS—Wah Chang Corporation, miner and refiner of tungsten, has bought the United States government tin smelter for $1,350,000 plus future payments. Wah Chang will close the smelter and remodel it to produce tungsten and tin alloys.

GRANTS, NEW MEXICO—The Sabre-P non Corporation has acquired rights to 3,000 acre-feet of water and 3008.83 acres of land in Secs. 6, 7, 8, 9, 17, 19, and 20, T. 11 N., R. 10 W., Valencia County, New Mexico from the Valencia Corporation for $375,000. The water and land will be used for a proposed 1,500-daily-ton uranium mill to treat Sabre-Pinon's Ambrosia Lake ore.

Mexican Silver Mines Interest Canadian Capital

A group of Canadian capitalists, in conjunction with Messrs. Vaupel and Garcia, have made arrangement with the various owners of silver mines in the Catorce mining district, about 200 miles north of San Luis Potosi, Mexico, for the consolidation of operations. They plan to develop the properties collectively under Canadian management at an estimated cost of $2,000,000. This includes erection of a cyanide plant.

This mining district has been inactive for many years because of inflow of water. In order to drain the mines, a deep level tunnel would have to be driven, or the Guadalupe Tunnel could be extended to reach the properties.

The following mines reportedly have entered the agreement: Santa Ana, Purisima, San Agustin, Concepcion, Padre Flores, San Pedro de la Agua Blanca, Delores Trompeta, and Candelaria.

AEC Signs Mill Contract For Grants, New Mexico

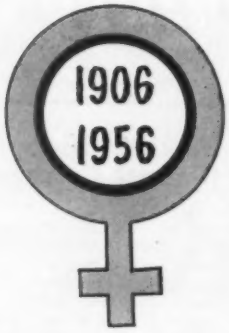
The United States Atomic Energy Commission has agreed to purchase the uranium concentrates to be produced by a new uranium processing mill which Homestake-New Mexico Partners will erect and operate near Grants, New Mexico. This is the first milling contract signed by the AEC to purchase concentrates produced from ores of the newly developed Ambrosia Lake area. Construction of the 750-ton plant is expected to get underway immediately, with completion scheduled for early next year.

Approval by the AEC clears the way for a contractual investment of about $10,000,000 by Homestake Mining Company in the Grants area. Under terms of the limited partnership agreement entered into by Homestake and its partners—Rio de Oro Uranium Mines, Inc.; United Western Minerals Company; White, Weld & Company; San Jacinto Petroleum Corporation; and Clyde Osborn—Homestake will invest $850,000 for shaft sinking, drifting, and mining equipment. Homestake will also invest about $5,500,000 in mill financing, an additional $1,500,000 in mill working capital, and $1,800,000 in a mill stockpile investment. In return, Homestake will receive a 25 percent working interest in the mining and milling of the ore from Sec. 32, T. 14 N., R. 9 W., belonging to United Western and its farmout group, as well as ownership interest in the mill.

Actual ownership percentages in the mill between the partners involved in the mill contract will be decided on a sliding formula based on ore tonnage put through the mill at the end of a five-year period, or by 1962.

Next Month—How Marquette Mining Floats Michigan Iron Ore

Union Miniere's Golden



By EDGAR SENGIER, K. B. E.

The year 1956 marked the 50th anniversary since the founding of our UNION MINIERE in the Haut-Katanga. We welcome the special invitation which has been extended to us by MINING WORLD to present its readers with a report concerning the achievements of our company.

On this particular occasion we will have to consider two different aspects of the results obtained: technical and social. If we are proud of our success in the technical field, we are so also with regard to what we have arrived at in matters of human concern.

The mineral deposits of our concession have revealed considerable quantities of high-grade ore (copper and other metals), but they lay in a region far distant from the sea in which we found neither human settlements nor roads when we began to put its mineral riches to use. The latter were, by their very nature, difficult to process. The African laborer whom we took from the neighboring territories, was completely inexperienced in industrial work.

The main factor of the success obtained in our enterprise lies in the persevering efforts we made to set up the mine and to make it prosper.

Right from the beginning we found ourselves confronted with the difficult problems of selecting the European staff, recruiting personel and labor, training and adjusting the native workers of the Congo. We have been in charge of the housing, the feeding, and the health of all these people; we had to study the technical problems connected with the extraction and the processing of the ore whose nature differed very much from that of the usual copper ore; we had to promote the establishment of a rail-network whose present length attains 2,700 miles, and of a wide net work of roads; at last, we had to found auxiliary companies whose task it was, in Africa, to provide the services and materials necessary to the development of our mining enterprises, and to secure refining facilities and markets for our products in Europe.

Today Union Minière employes some 2,000 Europeans in Katanga and some 600 in Belgium, of which 200 are scientists and engineers. All of them have given us proof of a spirit of enthusiastic cooperation, of which we feel very proud.

In Africa, some 21,000 native workers and employees collaborate with our white personnel, thus forming with it an industrial community of the Belgian Congo that has evolved tremendously and whose production improves as time goes by.

The high degree of mechanization in our industrial installations is guaranteed by the kind of working and living conditions from which the staff, as well as labor, benefit to a large extent.

With the help of a medical service consisting of 30 doctors and 100 nurses and assistants, all from Europe, we have been able to improve the health of the native workers in our settlements who number above 80,000 people. For the social welfare of our workers, we have created different centers which take special care of the schools which we have organized in the most appropriate ways for children, adolescents, and adults.

In 1955, our company produced 259,000 short tons of copper, 9,440 of cobalt, 126,000 of zinc concentrate, 58 of cadmium, and important quantities of radium, germanium, silver, and concentrated uranium.

Contrary to the procedures adopted in the United States where the consumption of the market surpasses by 400,000 tons the national production, the Belgian Congo has to distribute nearly all the copper far away and huge quantities find themselves dispersed all over the world at any moment before they reach their final consumer.

In the factories between ourselves and our clients, we have some permanent 90,000 short tons of copper. We sell through an independent commercial organization in 19 countries situated in Europe, in America, and in Africa. Similar circumstances do prevail in all of our lines of productions.

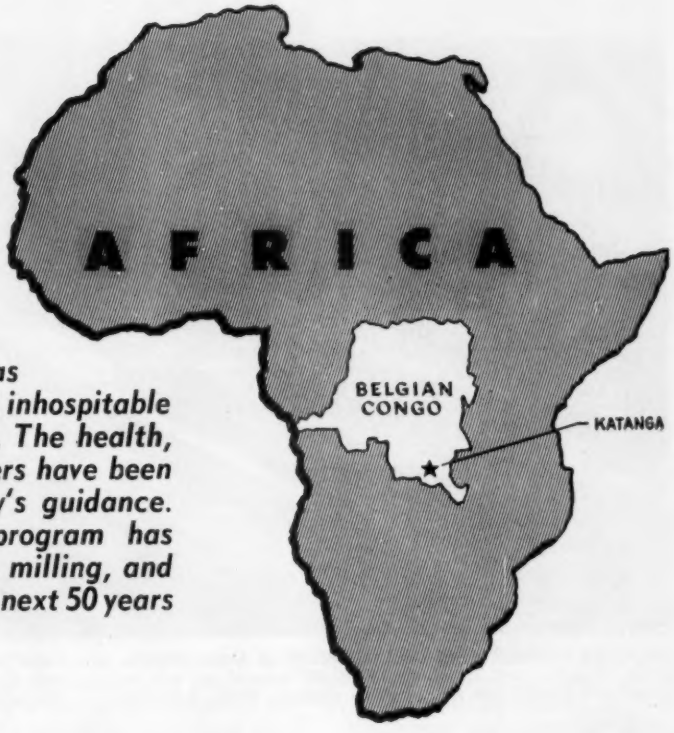
In the course of its existence, Union Minière has put into application a great number of working methods and specific metallurgic procedures which had been developed in the mines, in the mills, and in the laboratories; all of them constitute an adaptation to particular local conditions for procedures already known. Some of the most recent problems will be exposed in the following pages.

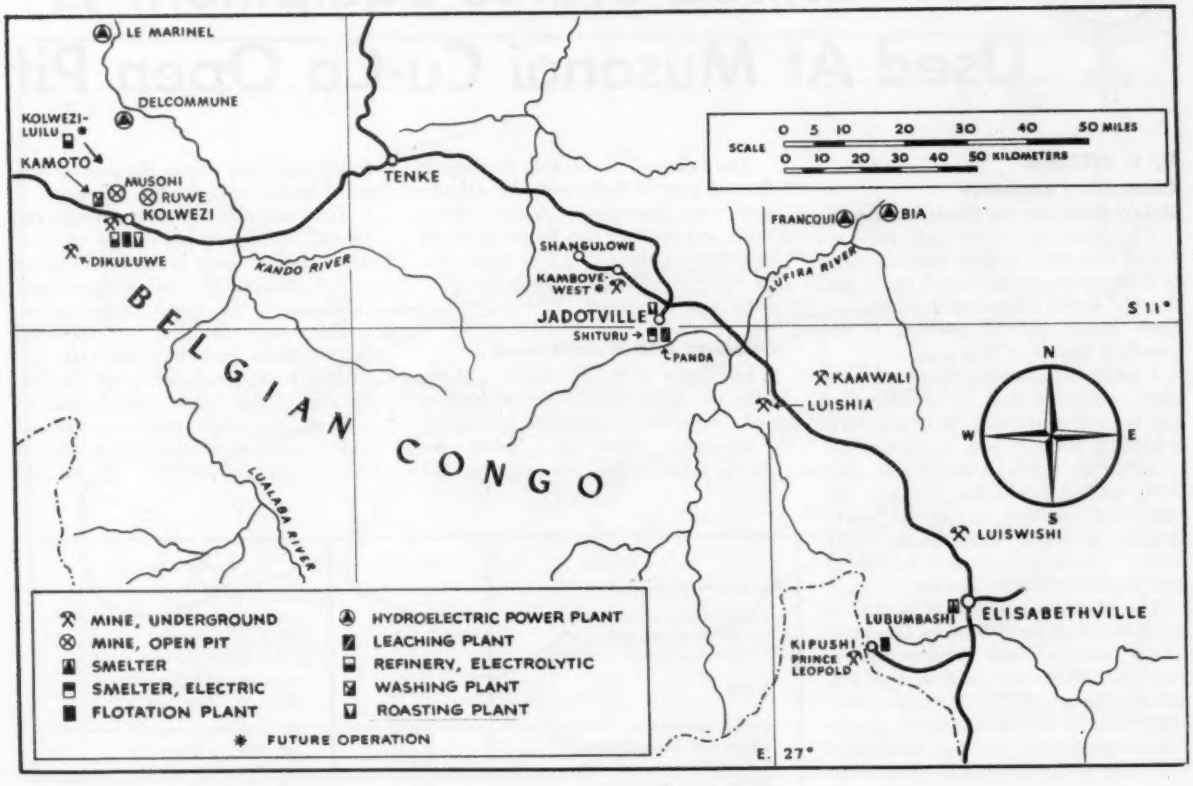
I sincerely wish that the publication in MINING WORLD of the problems we are confronted with may be a useful contribution to the rapid technical progress which the mining and non-ferrous metal-industry has steadily realized in the course of these last decades.

Mr. Sengier is chairman of the Permanent Committee of the Union Minière du Haut-Katanga. He recently was honored by Her Majesty Queen Elizabeth of the United Kingdom and knighted in the Order of the British Empire.

Jubilee

Union Miniere du Haut Katanga is one of the world's great mining companies. In 50 years it has become the largest producer of cobalt, the third largest copper mine, and an important producer of germanium, zinc, silver and uranium. . . . . It has brought civilization to a remote and inhospitable section deep in the heart of Africa. The health, welfare, and education of the workers have been vastly improved under the company's guidance. . . . . An aggressive research program has developed new methods for mining, milling, and refining the complex ores so that the next 50 years will assure even greater progress.





LARGEST COPPER AND COBALT MINE of Union Minière is the Musonoi open pit where 55,000,000 tons of ore will be mined and 345,000,000 tons of waste stripped. Waste is hauled out of pit in railroad cars and trucks haul the ore to the Kolwezi mill shown at the top right. Pit is wet following rain storm. For safety no electric caps are used because of storms.

1906
1956

How United States Equipment Is Used At Musonoi Cu-Co Open Pit

By E. WEBERG
Consulting Engineer
Union Miniere du Haut Katanga

The Musonoi open pit mine is Union Minière's largest mine in point of both tonnage mined and metal produced. About 50 percent of the annual copper and 85 percent of the cobalt is mined at Musonoi.

United States equipment plays a most important part in all stripping and mining operations. Stripping ratio is high, at seven to one, in comparison to ratios at many United States pits. Both rail and electric haulage are used; rail haulage, largely for waste because of longer distances to dump areas. Trucks give greater selectivity and flexibility for ore haulage.

The Musonoi open pit is located in what is called the "Western Group of Mines" of the Union Minière concession, 330 kilometers northwest of Elisabethville, capitol of Katanga province, and 80 kilometers north of the Rhodesian border. Average altitude of the area is 1,450 meters above sea level.

The railroad, connecting Katanga to the sea port of Lobito on the Atlantic coast in Portuguese West Africa, skirts and services this Western Group of Mines. Lobito is 1,775 kilometers by rail from Kolwezi where the company staff is housed.

Geology and Weathering

Like most of the ore deposits of the Katanga, Musonoi is in sedimentary rocks, essentially dolomitic in composition and called the "Série des Mines." This series is composed of the following units from the top downward as shown in the box below.

The outcrops of the "Série des Mines" in the area are due to an overthrust fault which brought the series to rest on rocks of much younger age, belonging to the Kundelungu system.

This major faulting, accompanied by numerous secondary fractures, has entirely folded and dislocated the formations of the "Série des Mines." As a result, the rocks enclosing the ore bodies occur as more or less separated blocks surrounded by a breccia

French Name	*Abbreviation*	*English Equivalent*
Roches gréseuses supérieures	R.G.S.	Upper sandstones
Calcaire à minerai noir	C.M.N.	Black ore limestone
Schistes dolomitiques supérieurs	S.D.S.	Upper dolomitic shales
BOMZ	BOMZ	From the English: Black Ore Main Zone
Schistes de base	S.D.B.	Lower dolomitic shales
Roches siliceuses cellulaires	R.S.C.	Cavernous siliceous rocks
Roches siliceuses feuilletées	R.S.F.	Banded siliceous rocks
Roches argilo-talqueuses	R.A.T.	Argilo-talcous rocks

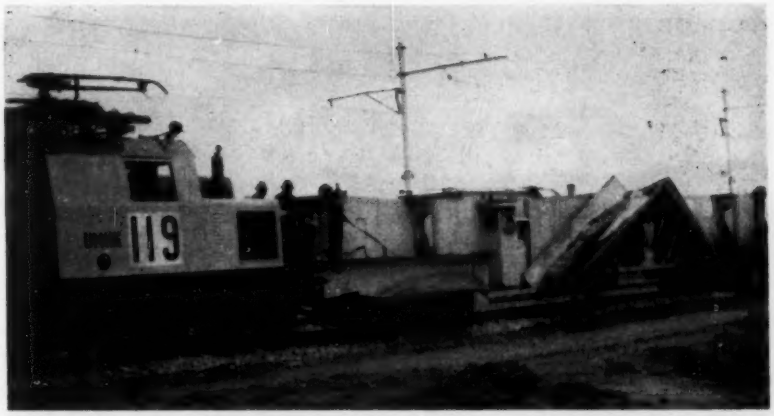
formed by the Upper Sandstones and the Argilo-talcous rocks.

These blocks vary considerably in size. Following the strike their actual depth ranges from scores of meters to a thousand meters approximately, according to the way the over-thrust sheet meets the underlying Kundelungu rocks.

The members of the "Série des Mines" in which the Musonoi ore bodies occur have a more or less east-west strike. As a whole they form an anticline followed by a syncline, but, due to erosion on the one hand and faulting on the other, only the limbs of these folds are sometimes left.

Deeper, where the rocks are unaltered, the mineralization occurs mainly as chalcocite (Cu_2S), bornite (Cu_5FeS_4), chalcopyrite ($CuFeS_2$), and carrollite (Co_2CuS_4) in two distinct ore bodies. The upper ore body is located in the Lower Dolomitic Shales and has an average thickness of about 10 meters. The lower ore body is located mainly in the Banded Siliceous Rocks and sometimes extends into the immediately underlying R.A.T. Its mean thickness averages 13 meters.

The R.S.C. which separate the two ore bodies have an average thickness of about 20 meters and are slightly mineralized. They owe their name to their appearance at the outcrops where, because of leaching and surface phenomena, they appear as pocketed siliceous rocks, while they are in reality quartzitic dolomites.

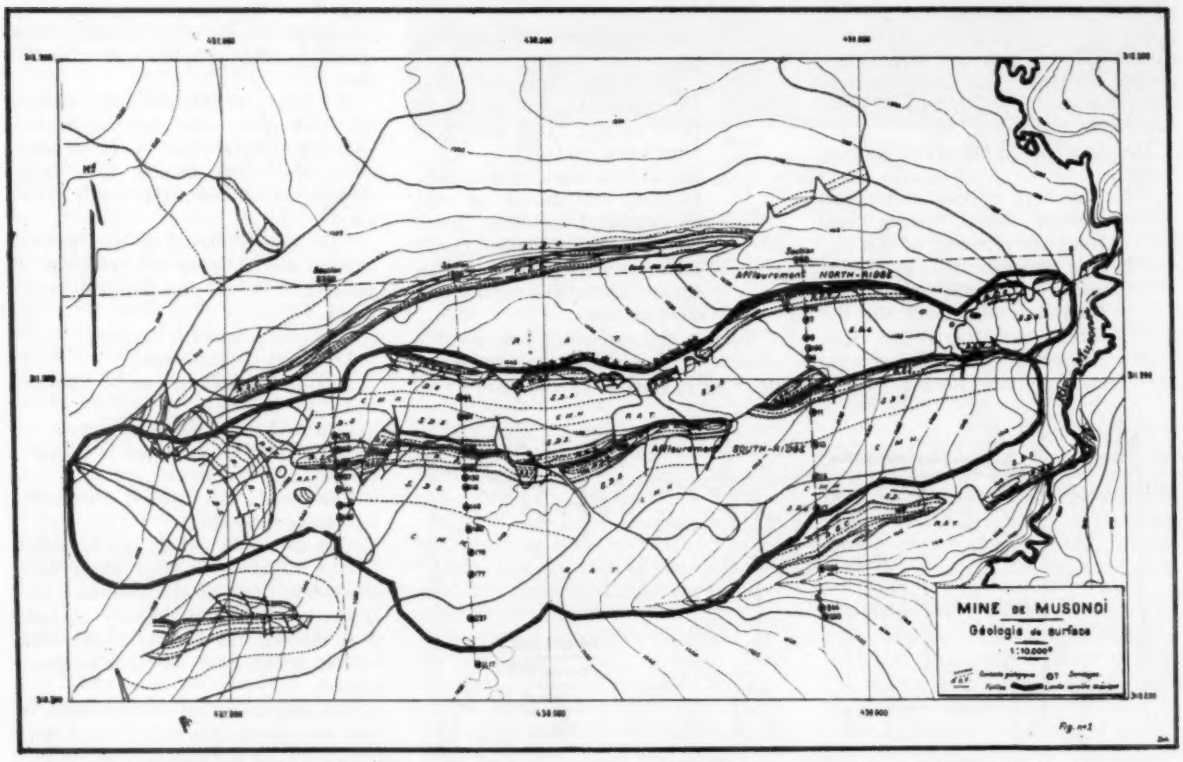


TRACK SHIFTING MACHINE manufactured in Germany is now used in all open pits and on waste dumps. This machine weighs 56 tons and is hauled by electric locomotive. In one hour 800 meters of track is shifted 1.5 meters by this machine.

The broken-up character as well as the high but essentially variable percentage of soluble elements contained in certain members of the series, together with the abundance of rainfall in Katanga, are mainly responsible for the great depth and irregularity of the weathering of the rocks.

One of the main consequences of this deep weathering has been the migration of the primary mineralization of the ore bodies toward the adjoining rocks containing the most soluble components. The R.S.C. formation has been particularly favored in this migration. In the weathered zone, this mostly barren rock has had about 50 percent of its volume enriched to form ore. On the other hand, the primary ore bodies have sometimes been leached of most of their mineralization. In the extremely weathered zones, the ore is mainly composed of malachite [$Cu_2(OH)_2(SO_3)$] and black oxides of copper and cobalt. In the intermediate zones, sulphides are intermingled with the oxidized minerals.

Weathering and migration of the minerals are responsible for the formation of ores of extremely different



SURFACE GEOLOGIC MAP of Musonoi pit showing formations, drill holes, and final pit area within solid black line.

MUSONOI PIT showing depth and number of benches. Two electric church drills, two electric shovels, and two Diesel trucks are shown mining ore. This picture, taken during dry season, shows how haul roads in foreground are wet down.

types and grades. This applies to copper and cobalt, the latter being essentially sporadic in its distribution.

Why Open Pit Mining Started

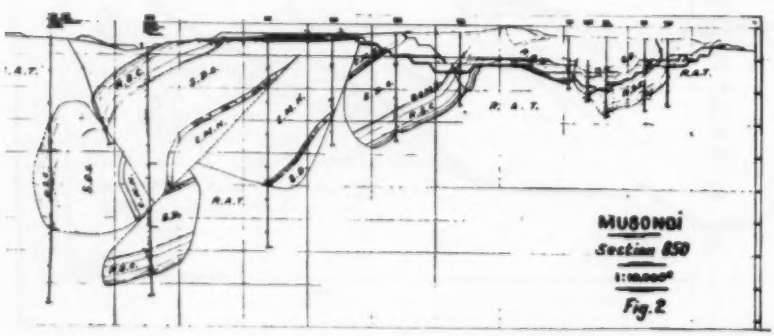
During the depression of 1935 to 1940, the Musonoi mine was worked on a small scale in a zone limited to copper ores rich in precious metals.

The open-pit operations for copper and cobalt ore started in 1942 on ore bodies cropping out on the surface. Mining limits were determined by the stripping ratio which had to be computed by comparing the operation costs of both open pit and underground methods. This ratio has been estimated at 11 or 12 tons of overburden for one ton of ore.

The main factors taken into account were:

1. The high copper and cobalt content which necessitated complete recovery of the ore.
2. The mineralization in altered zones outside the primary ore body and especially in the R.S.C. formations are sporadic and their recovery by underground mining would be uncertain or very costly.
3. Some low grade ore, which cannot be treated economically for the time being, may be recovered either in the overburden or the ore body for further use, should it prove of some value in the future. In the case of underground mining, this ore would have to be extracted immediately, notwithstanding the cost, otherwise it would be irretrievably lost.
4. The dislocation, and also the dip, of the beds which averages 30 percent do not allow underground mining on a profit-earning basis (See geologic cross section.)
5. In altered zones the sandy, hanging wall cannot be held underground without complete support; hence, costly mining methods, such as square setting and top-slicing, must be used.

Taking the foregoing into consideration, it is planned to extend the open pit operations to the 1,250 level, that is 200 meters below the average surface level.



GEOLOGIC CROSS SECTION showing how ore beds S. D. B. and R. S. F. are faulted.

Pit Planning

The overburden is soft, and little or even no blasting is required. As the expense of transport of the waste ranks foremost in the cost price, all transport must be effected by rail.

It is intended to extract the ore from the 150 section to the 2,350 section, that is 2,200 meters along the beds of the "Série des Mines". The greatest surface width of the pit will be 950 meters. Its total area will reach 420 acres (See plan map).

The bottom of the pit will be irregular, depending upon the mineralization.

The total excavation volume will be close to 200,000,000 cubic meters or about 400,000,000 tons. Of this 55,000,000 tons will be ore with an average stripping ratio of 7 to 1. Up to the beginning of 1956, 55,000,000 cubic meters had been excavated. (1.0 metric ton = 1.1 short tons; 1.0 cubic meter = 1.3 cubic yards).

Waste haulage is done mainly by electric locomotives. The rail will reach the 1,330 level and about 85 percent of the overburden will be moved in this manner. Waste located under the 1,330 level will be dumped into the mined out parts of the deposit.

The ore, as well as the waste, enclosed in the mineralized zones is transported mainly by trucks, which makes possible a better sorting of the ore.

To 1954, 35,000,000 cubic meters of overburden were dumped in several depressions close to the deposit. Now, the waste is sent to a large depression 3.0 kilometers north of the pit.

The ore is classified into several groups according to the processes of concentration or metallurgical treatment.

The main classes of ore are:

Oxidized flotation ore.

Oxidized cobalt ore to be concentrated by washing.

Oxidized direct leaching ore.

Mixed and **sulphide ore** to be concentrated by flotation.

Low grade ore stocked separately for future treatment.

The washable cobalt ore is railed to the Kamoto washing plant four kilometers west of the Musonoi pit. If this ore is not sufficiently altered, it is stocked for further weathering before being sent to the washing plant.

The copper ore for concentration is sent straight to the mill located 400 meters east of the Musonoi pit on the opposite bank of the Musonoi River.

The pit has two main outlets: the first one, toward the east, on the 1,400 level is used mostly for conveying ore to the mill or the stock piles; the second, on the western end of the pit, is utilized for hauling waste to the dumps.

Mining Techniques

The benches are usually 10 meters high. They are sometimes lower when trucks are used and when careful selective mining is necessary.

To control the efficiency of the drilling equipment and operation, the rocks are classified into three types on the basis of the time required to drill and flush one meter of a 6¾-inch-diameter hole with a 29 T Bucyrus-Erie churn drill equipped with a 875 kilogram tool string. This time varies from six to 25 minutes. Some very compact silicified rocks are too hard to be drilled by a 29 T churn drill and are a separate class.

The drilling equipment consists essentially of 29 T and 42 T churn drills equipped normally with 6¾ and 9-inch bits. In hard formations, the 42 T drill is used with 7-inch bits but with the same 1,800-kilogram tool string as with the 9-inch bits; hence an increase in drilling speed from 15 to 25 percent.

The rebuilding of the drill bits formerly included an oil-furnace-heating before tempering. The oil furnace has been replaced by a salt bath furnace which greatly improved the wear resistance of the bits. The footage drilled by a bit before rebuilding has increased by 40 percent.

Ingersoll - Rand Quarry - Masters, QMC model, equipped with tungsten carbide bits, are used in exceptionally hard rocks where it took two shifts for a 42 T to drill an 11-meter hole.

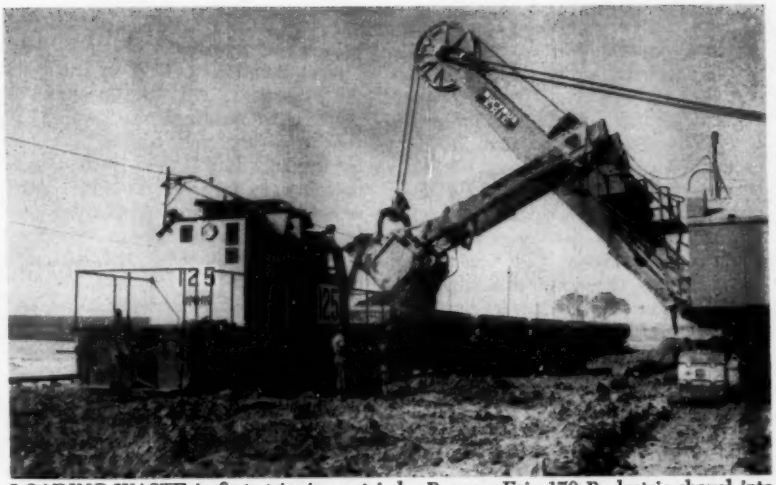
In soft ground the holes are drilled to the foot of the bench, while in hard rock they go one meter below it. Holes are drilled in staggered rows and are spaced from 4 to 7 meters apart depending on the hardness of the rock.

The overburden is soft and requires less than 15 percent of the total drilling and blasting. The remaining 85 is needed for mining the mineralized zone; especially the R.S.C. formation. When unaltered this formation is a very compact dolomitic quartzite. In altered zones, the washing out of the soluble elements has created a pocketing of a very irregular character, which represents from 15 to 30 percent of the total volume. This pocketing hinders the efficiency of the explosives and leads to bad fragmentation.

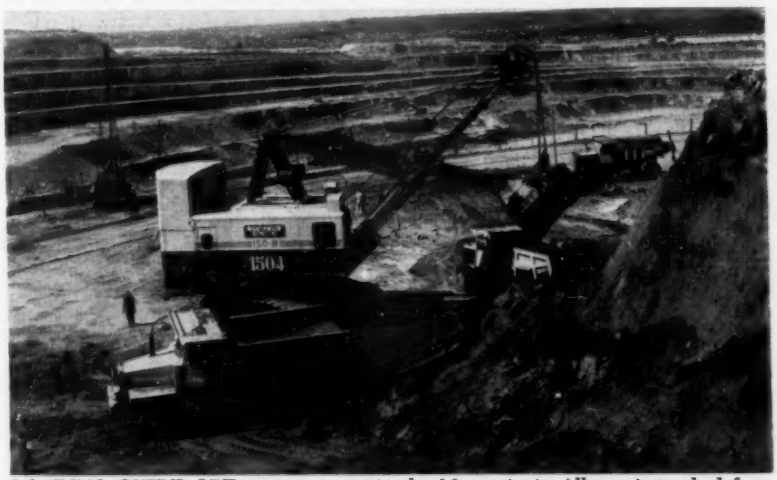
The expenses entailed in mining the R.S.C. being most important, the choice of the explosives and the methods of blasting are governed by this mining. Very often the drill holes are spaced only 3.50 meters apart.

The explosive is manufactured in Katanga in 6 by 8-inch cans weighing 8 kilograms. It has a strength of 75 percent of that of blasting gelatin, is water-resistant, very heavy, and has a high velocity of detonation. Two or three deck charges are used to get better fragmentation, except in soft ground where only a small bottom charge is sufficient. Tamping is done with sand and water. This stemming fills the natural voids of the rock and produces better confinement of the charge.

Primacord with 20 millisecond delay connectors is used for firing. Electric firing caps are not used because of the frequent thunderstorms occurring six months a year. Twenty to 50 holes connected in several groups are fired together in one blast.



LOADING WASTE in first stripping cut is by Bucyrus-Erie 170 B electric shovel into 28-cubic-yard, Austin Western, side dump cars. Loading, hauling, and dumping of waste are most important cost items in the mining cycle.



LOADING OXIDE ORE at grass roots in the Musonoi pit. All ore is trucked from the pit. Shown here are 20-ton Euclid Diesel trucks. Small trucks are used where more selective mining is necessary because of grade and/or oxide, mixed, or sulphide type.

The fragmentation obtained allows a satisfactory 4- or 5-cubic-yard shovel operation. Nevertheless, some secondary blasting is necessary. It requires from 1 to 2 percent of the total powder consumption. Drilling 1½-inch holes for secondary blasting is done by jackhammers with air from mobile compressors.

Tests and evaluations of drilling equipment and blasting methods are frequently made with the object of increasing fragmentation in the R.S.C. The present tendency is towards smaller diameter holes, more closely spaced, with larger continuous charge.

Loading and Hauling

Shovels are 4-, 5-, 6- and 6½-cubic-yard, Bucyrus-Erie, 100-B, 120-B, 150-B, and 170-B types. All are electric shovels using, 2,200 volts a.c.

Four, 4- and 5-cubic-yard shovels are used for mining ore. This is more than needed to feed the mill, but

some of them are standing by to meet any mill requirement for various kinds of ore without frequent shifting from one bank to another.

Haulage and dumping of the overburden is an important item of the excavation cost. The railroads are 42-inch gauge which is standard for Katanga and South African Railways. The 30 kilograms per meter rails are being replaced by 40. The ties, made of local wood, are sawed to 2.2 by 0.3 by 0.3 meter. Twelve to 15 ties are used for 10 meters of track.

Rails used to be fastened to the ties by spikes. This is being replaced by the "Nebelung" system used on a large scale in lignite mines of Germany. The Nebelung bond consists of a plate bolted to the tie carrying two eyelets enclosing the flange of the rail. A pin inserted in each eyelet rests on the flange. The surfaces of contact—eyelet-to-pin, and pin-to-rail—are such that the pin is easily inserted and removed by hand.

The limiting gradient of the track is 2 percent. All the locomotives, many are Westinghouse, weigh 70 tons and are trolley-type with two bogies and four axles. Each axle is driven by a 600-volt d.c., 160-horsepower motor. Some locomotives used for special purposes are equipped with cable reel, or electric batteries, or Diesel-electric generators.

All the tracks servicing mine and dumps are equipped with 600-volt d.c. overhead lines. Tubular, 5-inch steel poles support these lines which are independent from the track.

To facilitate the shifting of the line, the 5-inch poles are being replaced by lighter 3- and 2-inch poles which are connected to the track; this allows line and track to be shifted together.

The 600-volt d.c. is provided by mercury vapor rectifiers fed by 6,600-volt a.c. These rectifiers are installed in railroad cars and may be easily moved. A rectifier, together with the car, weighs 43 tons.

Dump cars are manufactured by Austin-Western and are of the all-steel, drop door, side dumping type. Their capacity is 22 and 28 cubic yards. Six or seven of these cars form a train which is hauled by a 70-ton locomotive.

Leveling and the shifting of the track is done by bulldozers. A new track shifting machine, manufactured in Germany and widely used in German lignite mines, was put into action last year on the dumps. This machine hauled by a locomotive weighs 56 tons. It shifts the track from 0.3 to 0.5 meter at a time. It takes about an hour to shift 1.5 meters away a 800 meters long track. Two more of these machines have been ordered and their use will become general in all open-pit mines.

Trucks have been in operation since 1947. They are used mostly for ore. They transport waste when the tonnage is small and does not justify laying a track, or when topography forbids the use of rail haulage. They are always used when the distance does not exceed 1,000 meters. Trucks most commonly used are 20-ton Euclids with 275- or 300-horsepower Cummins engines. Thirty out of a total of 95 trucks owned by the Company are in operation at Musonoi.

Caterpillar D8 bulldozers and Caterpillar 12 motorgraders are used for laying tracks and building roads. The road gradient does not exceed 8 percent.

STRIPPING ON UPPER BENCH with Bucyrus-Erie electric shovel. In this area the overburden is soft and can be dug without blasting. Waste trains are hauled from the pit by 70-ton Westinghouse locomotives powered from overhead trolley.

LOADING OUT ORE POCKET with 170 B Bucyrus-Erie shovel. Trucks give flexibility necessary to reach the tapered cut. Caterpillar bulldozer is used for spill clean up around shovel. Floodlights on bank at left are used for night loading.

Drainage

Originally the water level was at 1,385 elevation, which corresponds to the level of the Musonoi River flowing in the vicinity of the deposit.

Pumping is done mostly by deep-well pumps. At present the flow amounts to about 800 cubic meters per hour. It is still too early to say what the inflow will be at deeper levels.

Labor consists mainly of natives under the supervision of Europeans. On the average one European supervises 20 to 25 natives. All the mining equipment, drills, shovels, locomotives, trucks, bulldozers etc., are manned exclusively by natives.

Workshops of the Group of Western Mines are responsible for the maintenance of all equipment. Shops possess a highly qualified staff and are equipped with modern machinery. Owing to the remoteness from the sources of supplies, very important stores of spare parts must be maintained.

THE END

HYDROELECTRIC POWER has accelerated the change from pyro to electro-metallurgical processes. This is the new 276,000-kva Le Marinel power plant.

ELISABETHVILLE is one of the modern cities of the Belgian Congo, built in the last 50 years to supplement the development of the mining and metallurgical industry of Union Minière.

Mining Paces Economic Development

Union Minière has brought a big change to Katanga Province in the last 50 years. The rich mineral deposits have been the reason for the remarkable development of the entire Belgian Congo.

Katanga 50 years ago was an isolated place in the very heart of Africa, more than 1,200 miles from the sea, and over 300 miles from the nearest railroad in Northern Rhodesia. The region had no resource of labor or agriculture. Its poor soil barely nourished a few famine- and disease-stricken native tribes.

Consequently the establishment of the mining and metallurgical industries was bound to have a marked influence on the development of the entire Congo. The requisite developments were the making available of a labor supply, and the creation of a vast transportation and power network comprising roads, railroads, power plants, transmission lines, etc.

The geological reports of professor J. Cornet, and the prospecting of Tanganyika Concessions Ltd. in the late 1890's and early 1900's indicated the enormous mineral wealth of the Katanga. In 1906 the development of these was assigned to Union Minière of Upper Katanga, a company founded on the joint initiative of the Special Committee of Katanga (the Congo government holding two-thirds of the shares), Tanganyika Concessions Ltd., and Societe Generale of Belgium.

First A Railroad Network

First, an extension of the railroad was undertaken and completed from Broken Hill, Southern Rhodesia to Elisabethville in 1910. Two additional rail links were built to assure uninterrupted communication. In 1928 a new line was completed westward across Portuguese Angola to the Atlantic Ocean. In 1932 a rail-Congo River link was completed to the port of Matadi on the Lower Congo. This is very important in transporting food supplies and labor to the area.

Power System Grows

As explained in another chapter, pyrometallurgical copper smelting was first carried on. This necessitated import of costly coke from the Wankai coal fields 750 miles south of Elisabethville. Successful metallurgical studies, plus the ready availability of water power sites, led to adoption of electrometallurgical processes. In 1925 a new concern, SOGEFOR, was founded to construct a dam and hydroelectric power plant at Coronet Falls on the Lufira River near the metallurgical plants.

In order to meet the increasing demand for more power, three other dams and plants were built and financed by Union Minière. On the Lufira River, the Bia plant with its natural dam embedded between the walls and situated a few kilometres down-stream from the Cornet Falls was finished in 1950. On the Lualaba, in the western part of the mining region, two power stations were founded: Delcommune (120,000-kva) with its concrete dam completed in 1953, and Marinel (276,000-kva) with a naturally embedded dam completed in 1956.

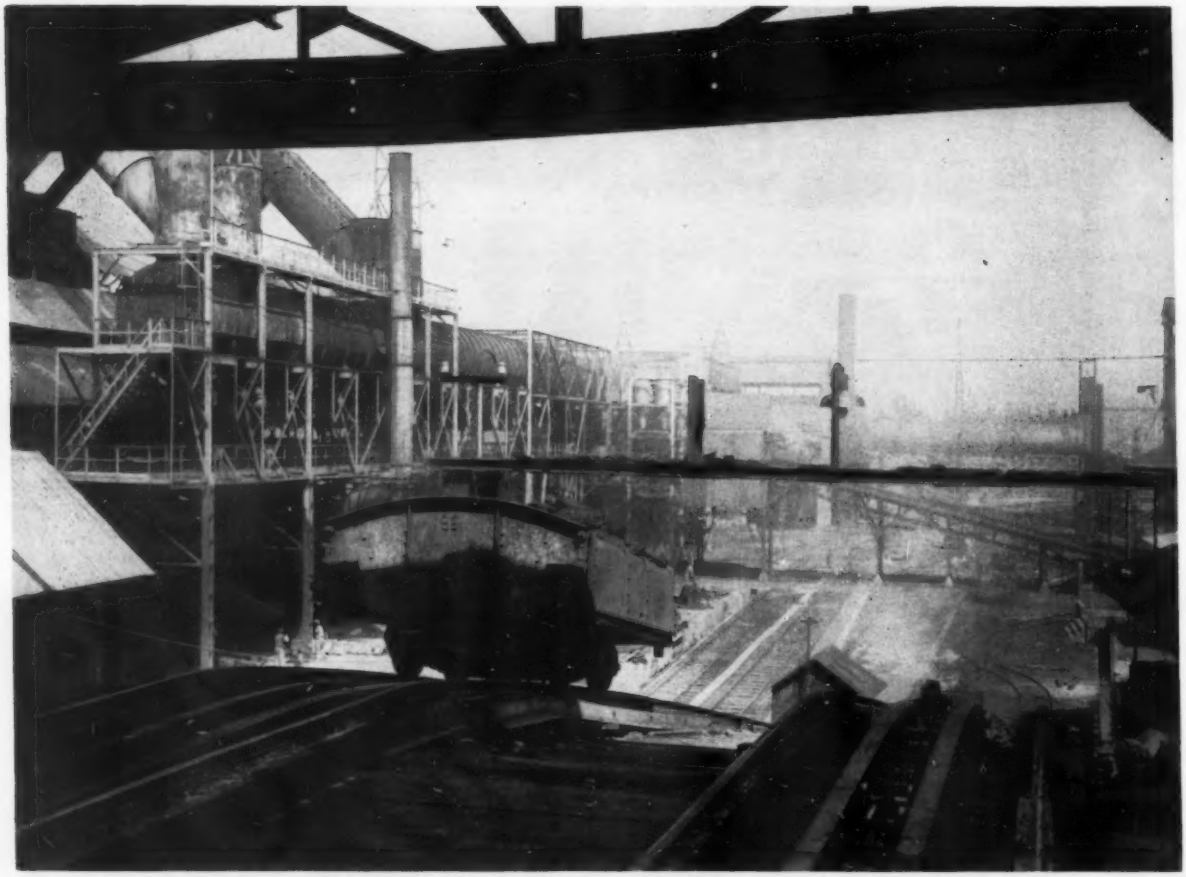
To support the mining and allied industries, there are now more than 4,000 industrial and agricultural establishments producing beer, tobacco, paper, shoes, cloth, furniture, etc.

The Company Today

Union Minière has indeed come a long way. Today it is the world's third largest copper producer with 8.0 percent of world output; it is the world's largest cobalt producer, 70 percent; a most important producer of uranium; and a major producer of germanium, cadmium, zinc, and silver. Sales in 1955 were 260,000,000. Its exports were 45 percent of the total from the Belgian Congo and its taxes, $56,000,000, pay 30 percent of the Congo budget.

Thanks to the joint efforts of public administration and private initiative, Katanga has become a prosperous province with modern cities of Elisabethville, Jadotville, and Kolwezi. These are in the very same area in which, hardly half a century ago, some backward tribes existed who were decimated by permanent diseases, wars, and starvation. Today, thanks to the riches of the mines and enterprise of Union Minière, a new and happy population of 30,000 Europeans and 1,500,000 Congolians live and keep improving themselves.

THE END



LUBUMBASHI SMELTER was the first plant built in the Congo by Union Miniere, and originally produced black copper by direct reduction of ore with coke. Today, blister copper is produced by matte smelting followed by converting.

1906
1956

50 Years of Growth Produces A Congo Metallurgical Empire

By THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

Ever since black copper was first produced by reduction of copper-oxide ores with coke in the water-jacketed, blast furnaces of the Lubumbashi smelter, near Elizabethville, the metallurgical complex of Union Minière has grown. Today, Union Minière ranks among the world's leading producers of copper (1955 production 259,000 tons); it is the largest producer of cobalt, accounting for over 70 percent of the total world supply; and the future is bright because present exploration, largely near Kolwezi, is constantly adding to known reserves of ore.

Over the years, two modern processing centers have been established by Union Minière for recovering metal values from the ores and concentrates produced by the company. Both were founded primarily to extract copper from Katanga ores; but as industrialization progressed cobalt-bearing copper ore was encountered and treatment methods were developed to extract the cobalt content. Copper-cobalt ores are generally found in the western part of the province, near Kolwezi. In the east, or more correctly, the southeast, copper-zinc sulphides are mined near Kipushi.

The first treatment facility to be built was the Lubumbashi smelter. This plant originally produced black copper, but now utilizes matte-smelting in blast furnaces with subsequent converting in Allis Chalmers, Pierce-Smith units to produce blister copper. The second center, is the great Jadotville-Shituru hydro-metallurgical and associated, electrolytic, copper-cobalt plants. A third center is now developing near Kolwezi in the west, and should be ready by 1959. This latter project involves treatment of copper-cobalt sulphides and oxides. It will include sulphate roasting, leaching and electrolysis to extract the metal from these western ores.

51 Years Ago

In 1906, Union Minière was given the right to prospect and develop all copper and associated metal-ore which was found in a district measuring 200 miles long by 31 miles wide in the Katanga Province of the Belgian Congo. In this mineral concession, with the exception of the copper-zinc sulphide lodes at Kipushi, the

ore is found in sedimentary formations embedded between barren horizons. The sedimentary series have been highly folded and fractured and in many cases they have been thrust over more recent formations forming blocks which outcrop in several places over a limited area.

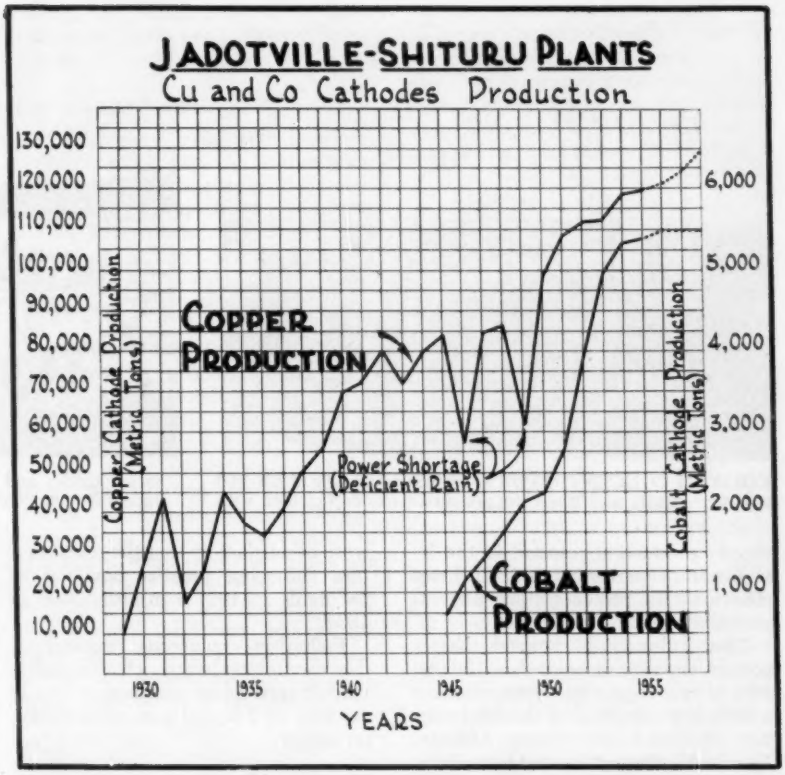
In the west, near-surface, copper ore is highly oxidized and occurs as malachite ($CuCO_3CU(OH)_2$), chrysocolla (CuO, SiO_2, H_2O) and cuprite (Cu_2O). At depth sulphide ore is encountered in increasing quantities. Cobalt is associated with the copper ore as heterogenite ($CoO2Co_2O_36H_2O$) or carollite (Co_2CuS_4).

The Lubumbashi smelter was built in 1910 to treat high grade copper-oxide ore furnished by the Star-of-Congo open pit mine. At that time potential hydro-electric resources were as yet undeveloped and the copper ore was melted in blast furnaces in which the flux was allowed to mix with the coke. Direct reduction of the ore proved to be very costly due to the high consumption of coke which had to be imported from Europe at the outset. Some years later, the Wankie coal fields in Rhodesia, 750 miles from Elizabethville, were developed as a source of coal supply; however, consumption remained quite high—3 to 4 tons of coal per ton of copper—due to the refactory nature of the ore. In succeeding years, the consumption of coal was reduced by means of washing low-grade ores, briquetting the concentrated ore, and by processing this ore on Dwight Lloyd machines.

Reverberatory Plant

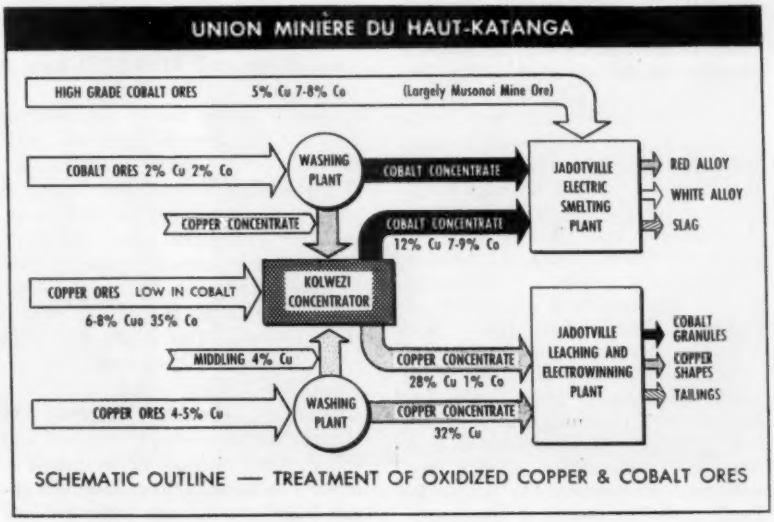
The ore for the Lubumbashi smelter was first mined locally near Elizabethville, but this source of supply was soon augmented by the developing mining district near Jadotville, 100 miles away. In 1921 a plant was erected in Jadotville for concentrating, by washing and precipitation, the ores mined nearby. The concentrated product was shipped to the Lubumbashi smelter, which in 1922 contained seven water-jacketed, blast furnaces.

The use of coke and the necessary packing of the charge, for the Lubumbashi smelter sparked the study for more efficient processing of ores without the usual Dwight-Lloyd sintering practice. In 1927 these studies resulted in the construction of a plant near Jadotville with four reverberatory furnaces. The Jadotville smelter subsequently treated the concentrates from the Jadotville-Panda concentrator, which in 1929, was equipped with a flotation section for copper oxides. This concentrator was the first of its kind, and was based on the use of a fatty acid collector; this reagent was later replaced with hydrolized palm oil of local production. The 1927 construction of the Jadotville smelter was the start of a second metallurgical center in the Katanga Province, and development of this plant is described later in this article.



Matte Smelting

As the amount of highly oxidized ore mined near Elizabethville dwindled, the extraction of the rich sulphide lodes near Kipushi began. Treatment of this mixed ore was done by partially desulphurizing the charge on Dwight Lloyd machines with greatly reduced consumption of coke to 1,000 pounds per ton of copper. The treatment of sulphuretted copper ore in the blast furnace was another procedure originated by Union Minière. From 1930 on, the Lubumbashi smelter began to produce 75 percent copper matte as well as raw copper ingots. The matte was first exported for refining, but the growing output of the matte at the expense of black



SCHEMATIC OUTLINE — TREATMENT OF OXIDIZED COPPER & COBALT ORES

KOLWEZI CONCENTRATOR at left has a capacity of 350,000 tons per month, and treats copper-cobalt oxides together with mixed oxides and sulphides. Concentrates are shipped to the Jadotville plants shown at the right.

copper production resulted in the installation of converters in 1945. From that time on blister copper was exported for refining in Europe.

The Lubumbashi smelter has a present capacity of more than 120,000 tons of raw copper per year, which is a little less than half of the total copper produced by Union Minière. Nearly all the concentrate feed for the smelter comes from the mines at Kipushi where a concentrator was installed in 1935. Other metals recovered from the Kipushi ores are zinc, lead, cadmium, silver, and germanium. However, unless a discovery of great significance is made at Kipushi, these lodes will be of diminishing importance in the future. But the extended program for electrolytic copper production from the Kolwezi area in the west will compensate for this expected reduction.

Jadotville-Shituru Plant

With water resources totally undeveloped, pyrometallurgical methods had been a necessity at the Lubumbashi smelter. However, the Katanga Province contained abundant, potential, sources of hydroelectric power, and early research was begun for the development of electro-metallurgical treatment of copper ores. An experimental plant was set up in Katanga as early as 1921 to test procedures with Katanga ores. It soon appeared necessary, however, to build a hydroelectric power station, a transmission line, a sulphuric acid plant and the Jadotville-Shituru electrolytic plant. These installations were completed in 1930. Initially the Jadotville-Shituru works were supplied with raw ore; but economic pressures resulting from the depression of the 1930's necessitated the replacement of this feed with concentrates from the Jadotville-Panda mill. The results of this change were so satisfactory that the reverberatory furnacing practice founded at Jadotville in 1927 was abandoned in 1932.

Following numerous expansions, the electrolytic works of the Jadotville-Shituru plant attained a yearly capacity of 140,000 tons of electrolytic copper.

Western Mines

General mechanization of the western open pit mines of Union Minière is very much advanced. During 1955, the mines of Musonoi and Ruwe produced 67 and 31 percent respectively of all the surface-mined copper. The Musonoi mine extends over more than 1.2 miles and contains copper and cobalt-bearing ores which, near the surface, occur in oxide form; at depth these minerals grade into sulphides. The great complexity of the mineralization requires selective mining methods and flexibility in the processing methods used for concentrating the ores. The extraction at the Musonoi mine totalled over 3,000,000 tons of ore and 11,000,000 tons of overburden in 1955.

The Musonoi ore is concentrated by flotation at the Kolwezi mill, built in 1941. The Kolwezi plant is composed of two sections; one section is used to recover copper-cobalt oxide minerals by flotation using hydrolized palm oil; the second section is used to treat mixed oxide and sulphide ore by differential flotation using a xanthate collector. The sulphide concentrate is given a sulphate-roast by the Fluosolids process which makes the concentrate amenable to leaching and electrolytic recovery of copper and cobalt. This method of treatment is utilized to completely recover the cobalt content of the ores in the Kolwezi region. Cobalt recovery is impossible under present furnacing methods used at the Lubumbashi smelter. The capacity of the Kolwezi mill has undergone several expansions and is now approaching 350,000-short-tons monthly.

Electrometallurgy Gaining

The ore beds of Ruwe, another big, open pit mine, form a clean basin that covers some 250 acres, and are 100 to 130 feet deep. The ore occurs in the form of oxidized, copper-bearing minerals, and is shipped to a washing plant which was constructed in 1950. This plant will handle 120,000 short tons per month of the soft Ruwe ore. In 1955, the Ruwe mine produced 2,800,000 tons of ore, and over 1,-300,000 tons of overburden was removed.

To compensate for the approaching exhaustion of the ore from the Prince Leopold mine at Kipushi, new copper-cobalt projects are being planned by Union Minière in the west and central portion of the district. These will involve open pit operations at the outset, to be followed by underground development at a later date since the ore extends to depth. Also included in this planning is a new copper-cobalt electrolytic plant to be constructed in the western part of the district. Mixed sulphide ores of copper-cobalt will be given a sulphate roast, then leached and sent to an electrolytic tank house in the projected new installation.

The supply of power for metallurgical operations at present is produced by four hydroelectric plants capable of generating some 2,500,000 kilowatt-hours annually. In order to meet the increased demands for power stimulated by the new program, a fifth power plant is now under study. This new power station should begin

to operate around 1965 and is expected to furnish an additional 1,400,000 kilowatt-hours per year. Though pyrometallurgical copper forms a sizable share of Union Minière output today, it is anticipated that 80 percent of the future copper production will depend on electric power.

Cobalt Recovery

As a rule, the cobalt associated with copper in certain beds in the Upper Katanga occurs in the form of oxides or hydrates. This contrasts with occurrences at most mines around the world where cobalt occurs as a sulphide or as an arenic compound. Two general methods of treatment are employed to recover the cobalt content of the Katanga ores depending on the physical association of minerals. Leaching followed by electrolysis is employed for low cobalt bearing ores or concentrates. Electric furnaces treat higher grade cobalt ore.

Certain ores from the Western mines contain relatively little copper. This ore is concentrated by palm oil flotation to produce a product containing 8.5 percent cobalt and 10 percent copper. Other ores contain virtually no copper and are amenable to concentration by simple washing practices. Oxide ore of the above two classes is reduced in a plant equipped with four electric furnaces near Jadotville. Treatment in the furnaces yields a white (blanc) alloy (Cu-Co-Fe), containing 46 percent, cobalt which is shipped to Olen, Belgium for further refining. The capacity of the Jadotville electric furnace plant is 4,400 tons of contained cobalt per year. The reserves of cobalt ore or cobalt concentrate suitable for treatment in the furnaces is necessarily limited. It is anticipated that in the future the electric furnaces method for treating cobalt will be of diminishing importance, and will be gradually supplanted by hydrometallurgical processing by which method a large amount of cobalt ore is already being processed.

Low Grade Cobalt

Certain ores from the Musonoi-Kolwezi mines and the Ruwe mine contain high grade copper (6 percent Cu) associated with 0.3 to 0.4 percent cobalt. This ore is concentrated and treated by leaching with subsequent electrolysis to recover copper at the Jadotville-Shituru plant. Cobalt follows copper into solution, and cobalt-bearing solutions following copper electrolysis are treated by an electrolytic procedure developed exclusively by Union Minière. The electrolytic cobalt section was put into operation in 1946, and cobalt cathodes obtained by electrodeposition are refined in an electric arc furnace, granulated and exported. In 1955, the production of electrolytic cobalt at the Jadotville plant reached 5,600 tons per year. Production from the Jadotville-Shituru plant is increasing; and to this figure can be added the projected output from the new electrolytic plant being constructed in the West.

Zinc

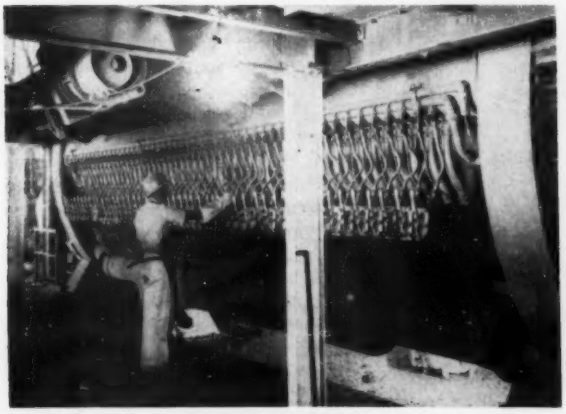
Zinc is found in the Upper-Katanga formations associated with copper in the deeper zones of the Kipushi lodes where underground operations began in 1927. The concentrator at the Prince Leopold mine was equipped for differential flotation in 1937 for the recovery of copper concentrate as well as zinc concentrate. Up to that time the zinc content of the ore accompanied the copper concentrate into the water-jacketed blast furnaces of the Lubumbashi smelter at Elizabethville. The mineralization of the Kipushi lodes is composed of chalcocite (Cu_2S), bornite (Cu_5FeS_4) and chalcopyrite ($CuFeS_2$) with a high proportion of zinc blende (ZnS). Flotation practice has been modified in past years in order to compensate for the variation in the ore extracted as the Kipushi district grew in extension.

A portion of the raw zinc concentrate is shipped to Belgium for further processing. The remainder is shipped to the Societe Generale Industrielle Et Chimique plants near Jadotville where it is roasted for production of sulphuric acid necessary for the Union Minière electrolytic operations. A portion of the calcined zinc concentrate is shipped to the electrolytic zinc plant of Societe Metallurgique De Katanga at Kolwezi. Remaining calcined zinc concentrate is exported to Belgium for treatment.

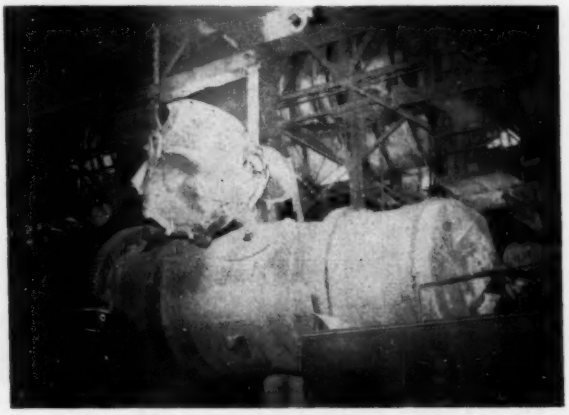
Other Metals

Cadmium and germanium are also associated with Kipushi ore. Since 1941, cadmium is recovered in the plant of Societe Generale Industrielle De Katanga from the calcination gas of zinc roasters. Cadmium sticks are obtained by chemical processing followed by distillation. Since 1947, cadmium and germanium-bearing flue dusts recovered from the Lubumbashi smelter were stockpiled until the completion of a special section of the Kolwezi electrolytic zinc plant in 1954 for processing of these dusts. At the Kolwezi plant the dust is leached and the solution, after precipitation of germanium oxide is treated electrolytically to recover cadmium. The cadmium cathodes are cast in sticks for commercial use. Precipitated germanium is shipped to the Belgian plant Usines Metallurgiques.

The flow of ore from mines to concentrators; and the flow of various concentrates to Union Minière's metallurgical plants is quite complicated. Various aspects of concentration and metal winning are treated in greater detail in several other articles in this issue. THE END

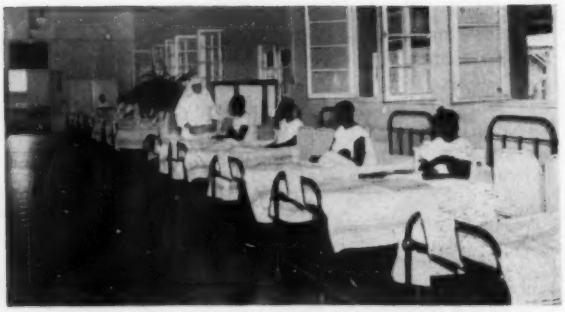


TUYRES for one of the Allis Chalmers, Pierce-Smith converters at the Lubumbashi smelter is shown at the left. At the right is a



rotary holding furnace ahead of the ingot and wire-bar casting operation of the smelter.

TRAINING PROGRAM for Natives has developed a skilled labor force in mines, metallurgical plants, and machine shops.



ONE OF SIX HOSPITALS operated by company's Health Service. Modern infirmaries and health clinics are also maintained.

Development and Training of Workers

The harmonious development of individual relationships is an essential factor in achieving industrial success—especially where an enterprise is established in an area remote from civilization. Then the company must provide, entirely on its own, for the needs and deeper aspirations of the people it employs. This is how Union Minière has tried to meet this problem over the past 50 years.

When the company moved into the area in 1906, it was inhabited by only a few scattered tribes unsuited to any industrial work. Right from the beginning, therefore, labor had to be recruited from distant regions like the Rhodesias and Angola, and then only on a six-month contact because local authorities were concerned about movement of their population. As late as 1925, 96 percent of total manpower employed was hired on an annual basis.

In spite of the improvements in food, housing, and general health, provided by Union Minière, these workers, separated from their homes and habitual social milieu, showed a very low efficiency. Any professional training was out of the question because of permanent renewing of labor. Management realized that the labor force, once hired, had to be made steady in the job.

In 1928 a new policy was inaugurated. With a three-year contract authorized by the government, the workers were encouraged to establish themselves with their families in Katanga. This program soon produced the most satisfactory results. This is the policy today:

Housing—The workers and their families are housed in special cities in which they find their accustomed social life. They are given individual living quarters with a parcel of ground around each house. Today there are about 21,000 of these workers who, with their families, form a population of nearly 80,000 people.

Hygiene—Since the three-year contract has been in effect, the company has been able to attend to the health service of each individual. Proof of the success of the program is shown in these statistics: the 1929 death rate was 31.4 per thousand; this was reduced to 7.1 per thousand inhabitants in 1955. The birth rate went up from 29.9 per thousand in 1929 to 72.9 per thousand inhabitants in 1955. The company's Health Service now operates six fully equipped hospitals, three infirmaries, and numerous health and welfare centers.

Education—A whole system of education has been set up by the company. Kindergartens and elementary schools are provided for boys and girls. Later the children are directed toward the type of work that suits them best or are encouraged to go to a professional school or high school. Graduates of these schools get jobs according to their choice in the different services of the company, or in the numerous industrial and commercial enterprises active in Katanga. The most gifted may go to one of the two university colleges in the Congo. In 1955 primary and professional schools had an enrollment of 15,000 students.

Social welfare—The company maintains all groups and organizations involved in religious or social activities for the benefit of its members. It encourages the workers to use their spare time meaningfully and arranges for sound social entertainment by the creation of libraries and forming of special interest groups that favor sports, music, etc.

Wages—Each worker, from the simple factory hand to the skilled employee, is assigned to a well-defined salary category. The unskilled worker considered incapable of establishing and respecting a family budget is paid partly in cash and partly in consumer goods, such as food, clothing, firewood, housing, etc. As his position improves, the worker is paid an increasing part of his salary in cash. The most advanced workers draw their salaries wholly in cash, and are also eligible for financial aid from the company in constructing a house outside the company's worker cities.

The wage rates are adapted to the rates paid in Belgium, with reservations made for worker efficiency and professional training. As a rule, all of the workers enjoy family allowances, pensions for sickness or old age, paid vacations, etc.

Conclusions—The social policy carried on by Union Minière in the Upper Katanga strives to meet the material, moral, and intellectual needs of the native worker in accordance with the degree of his social integration and his character development.

Within the near future the company expects to have to face the problem of integrating the advanced native into the European staff. Already mixed counsels and groups of staff workers are sitting in on conferences to permit the two races to know each other better, and to grow in reciprocal understanding and mutual esteem. It is hoped that with good will and common sense on both sides, there shall be no obstacles that cannot be overcome.

The harmonious relationships in human and social affairs are of capital importance for an enterprise. Its success and prosperity will depend largely on the joint and freely consent effort made by all the members involved in the common task.

THE END

1906
1956

Top Slice Mining At Kipushi

By E. DEFOURNEY
Consulting Engineer
Union Miniere du
Haut Katanga

The Prince Leopold mine of Kipushi is Union Minière's largest underground mine. More than 1,000,000 metric tons of high-grade ore are now mined each year by top slicing with an underground crew of 90 Europeans and 2,200 natives. Kipushi is one of the world's major metal producers with 2,000,000 tons of copper, more than 2,000,000 tons of zinc, and 3,500 tons of silver recovered to date from 16,000,000 tons of ore.

An elaborate dust prevention system featuring special ventilation is used at the mine. A unique mine drainage and pumping plant takes care of all sudden and large inrushes of water. The pumps are placed in water tight stations so that the mine can be flooded to put out any fires in the timber mat and then pumped out so mining can be resumed.

The mine is less than 30 kilometers from Elizabethville. It is some 1,200 meters above sea level and only several hundreds of meters from the divide between the Congo and Zambezi rivers; a line which forms the boundary between the Belgian Congo and the Federation of Rhodesia and Nyasaland.

High-Grade Ore in Lode

While the mineralization in Katanga Province is generally localized in specific beds of the Serie des Mines, it occurs at Kipushi in the form of a lode along a contact between a thick dolomite-limestone bed (younger) and the beds of the Serie des Mines proper. See diagram of vertical section of ore body. The lode is rich in sulphide minerals of copper, lead, zinc, iron, and, accessorily, lead, silver, cadmium, and germanium. Predominant minerals are: chalcopyrite ($CuFeS_2$), bornite (Cu_5FeS_4), and sphalerite (ZnS). Mineralization extends over a length of 500 to 600 meters, and has a width of 20 to 60, or even more. Above the water level which is 80 meters below the surface the ore was oxidized.

Underground mining began in 1925 on level 65 after surface open pitting. The original 25-meter level interval, later 35, was finally extended to 50 with two intermediate sub levels.

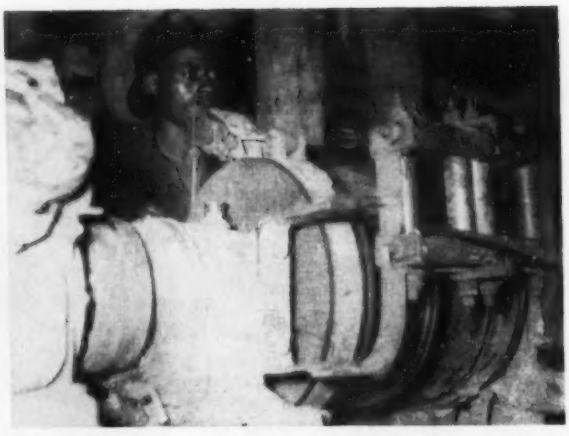
The mine is developed through four shafts. A main hoisting shaft, an air

PRINCE LEOPOLD MINE OF KIPUSHI is Union Minière's largest underground mine. It is developed through three shafts shown above. Separate shafts are used for hoisting, ventilation, and pumping. Timber for top slicing is stacked in foreground.

For High-Grade Copper-Zinc . . .

NATIVE MINER drilling with air leg mounted machine. He is one of 2,200 natives who work everyday in the mine. Special ventilation methods, including use of coagulation aerosolution, are used to insure that no dust is breathed by miners.

PUMP STATION on the 500 level. The pumps have a combined capacity of 9,000,000 gallons per day. Water is pumped out separate shaft. Watertight doors prevent pump flooding.



SLUSHING ORE into raises in the top slice stopes. Ore is drawn from these raises and trammed to hoisting shaft with compressed air powered locomotives.

shaft, a service shaft, and a pump-column shaft. Air courses down the hoisting and service shafts, through the haulage crosscuts, into and through the stopes, and is exhausted through the air shaft which has a surface ventilation plant.

How The Ore Is Mined

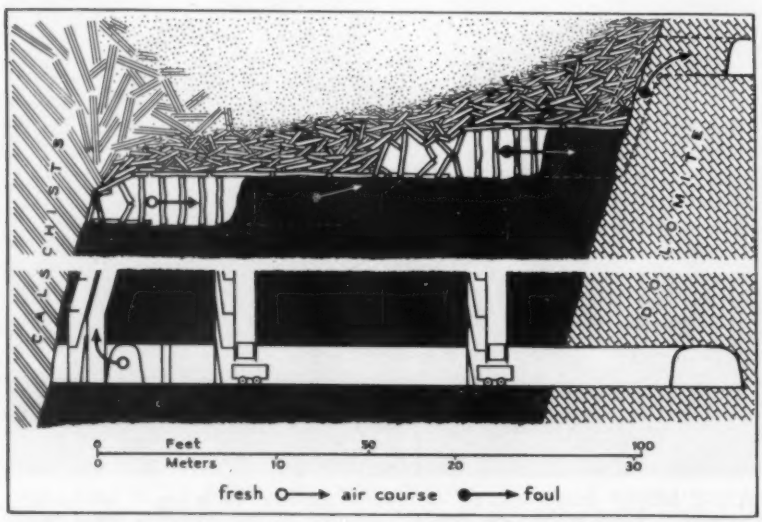
On each level and each sub level the lode is developed by a series of crosscuts at 15 meter intervals driven from footwall haulage drifts. From the crosscuts, raises are driven at 12-meter intervals in the ore. These workings serve for the extraction of ore, for air circulation, for the transportation of mine pesonnel, and for movement of timber and diverse material.

Underground mining first started by square setting with filling. By this method, all the ore of a particular high grade was recovered. This ore, weighing several thousands of tons, assayed more than 30 percent copper. Unfortunately, the square sets consumed huge quantities of large-sized framed timber whose transportation into the stopes proved to be very difficult. The output per man was low and the mine production small. For these reasons square sets were soon abandoned and replaced by top slices which, it is true, still necessitate much timber. However, this timber can be of a smaller diameter, of lower quality, and without any complicated framing. In addition it can be easily handled and transported in the mine.

Also, for some time sub level caving stopes have been developed where low-grade copper mineralization occurs.

Top slicing proceeds by slicing cuts three meters in height. In the central part of the ore (see level plan diagram), longitudinal stopes were extended along the bed, starting from the top and mining downward and to both walls. In this case the thickness of the ore block measures only 15 meters which is the distance between the axis of the raise-chute lines and each floor and sub floor. However, in most cases the slice area covers two, three, and even four raise lines. The timber mat caves by itself without any undermining as the posts break and fall, with the entire mass of timber collapsing.

All ore is broken by explosives, scraped into chutes, drawn into small cars on the lowest level of the stope, and trammed to the hoisting shaft. The cars are hauled by compressed air motors as the distance is not long enough to justify electric locomotives. The hoisting shaft is equipped with five-metric-ton skips which each hold three cars of ore.



MINING DIAGRAM showing how the ore is mined and the top slice stopes ventilated.

To Mine 1,000 Tons It Takes

For every 1,000 metric tons of ore mined by top slicing it requires: 185 lineal meters of post 15 to 18 centimeters in diameter; 200 lineal meters of framed timber 10 to 15 centimeters in diameter; several tons of small timber for the mat; 225 kilograms of 74 percent powder; 378 working days of native labor which corresponds to 2.7 tons per man per day; and eight European supervisory shifts or 125 tons per day per supervisor.

Mine development and stope preparation to mine this 1,000 tons of ore require: Five lineal meters of underground opening (drifts, raises, etc.); timbering of 3.5 meters of this opening; 900 meters of drill hole; 330 kilograms of 74 percent powder; 575 working days of native labor which is equivalent to 1.8 tons per man per day; and 13 European supervision

shifts or 75 tons per supervisor per day.

Blast holes are drilled with 2⅝-inch percussion drills, with water injection, weighing about 30 kilograms each. Drills are mounted on air legs. Coromant chisel type steel is used. Each steel drills an average of 225 meters of hole.

Well Ventilated Mine

Although the silica content of the ore and enclosing wall rock is negligible, special precautions are taken to insure a minimum amount of dust. Special dust allaying measures are: Superabundant ventilation; separate inlet and exhaust airways with fresh air channeled along special hanging wall drifts, up raises into and through stopes, with the polluted air flowing to footwall drifts and then to the air shaft. All blasting is done at the end of the shift after men have left the mine. Special water sprays are used in all slices to wet down the muck pile; further spraying of ore is done during slushing; also all polluted air is sucked through a water spray before exhausting to surface.

A special fresh air course 1.5 meters wide is maintained in the ore just under and along the hanging wall on each level. Air raises extend from this air drift into the stopes. This raise is timbered and subsequently filled with coarse waste so that air circulates after the timber collapses.

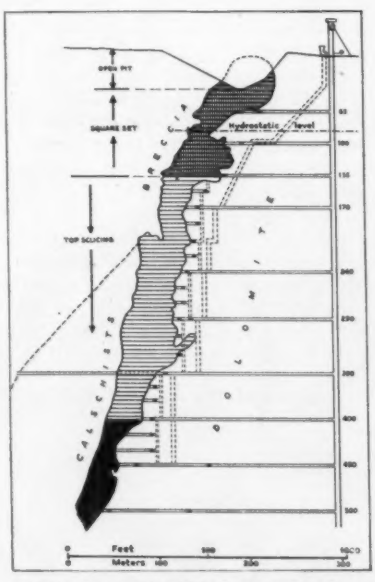
Anti-dust measures are completed by the use of a unique coagulating aerosolution (described in 1954 Essay on the Prevention of Silicosis by Union Minière du Haut Katanga) of sodium aerosol chloride which is sprayed into the fresh air stream on each mine level. This spray has the ability of catching and binding individual dust particles together. These coagulated particles are large enough so that they are trapped in the upper respiratory organs during breathing. Consequently the special spray reduces the number of those minute dust particles which actually are inhaled into the lungs.

Regular checks are made on the entire ventilation system and dust counts are taken in all working places.

Special Pumping Methods

The dolomite beds which form the Kipushi footwall act as a water collector for the entire region. The mine always must face the unexpected inrush of huge quantities of water and is exposed, in its deeper levels, to the risks which arise from mining adjacent to the dolomite whose many hidden caverns contain much water stored under pressure. The pump stations have their own shaft which is not connected with the rest of the mine except by the sluice gates which direct the water to the pump stations. These are fully protected against all possible dangerous incidents in the mine proper. Speaking about unforeseen events, it may as well be mentioned here that the water available from the pump stations serves very efficiently for the fighting of any fires. The timber mat on top of the slices generates heat, which, at times, causes spontaneous combustion. As a rule, it is practically impossible to check fires in the mat with ordinary fire extinguishers. When a fire breaks out, the sluice gates on the mine side of the pump stations are shut, the water begins to rise, soon floods the mine, and submerges the fire zone. After the fire is extinguished, the gates are opened, the pumps are restarted, and mining is resumed after the water has been pumped out.

BLOCKING POST in top slice stope. Top slicing replaced square set mining because of the difficulty in obtaining and handling large timber. True, top slices use a lot of timber but of smaller diameter and inferior grade which can be cut locally.



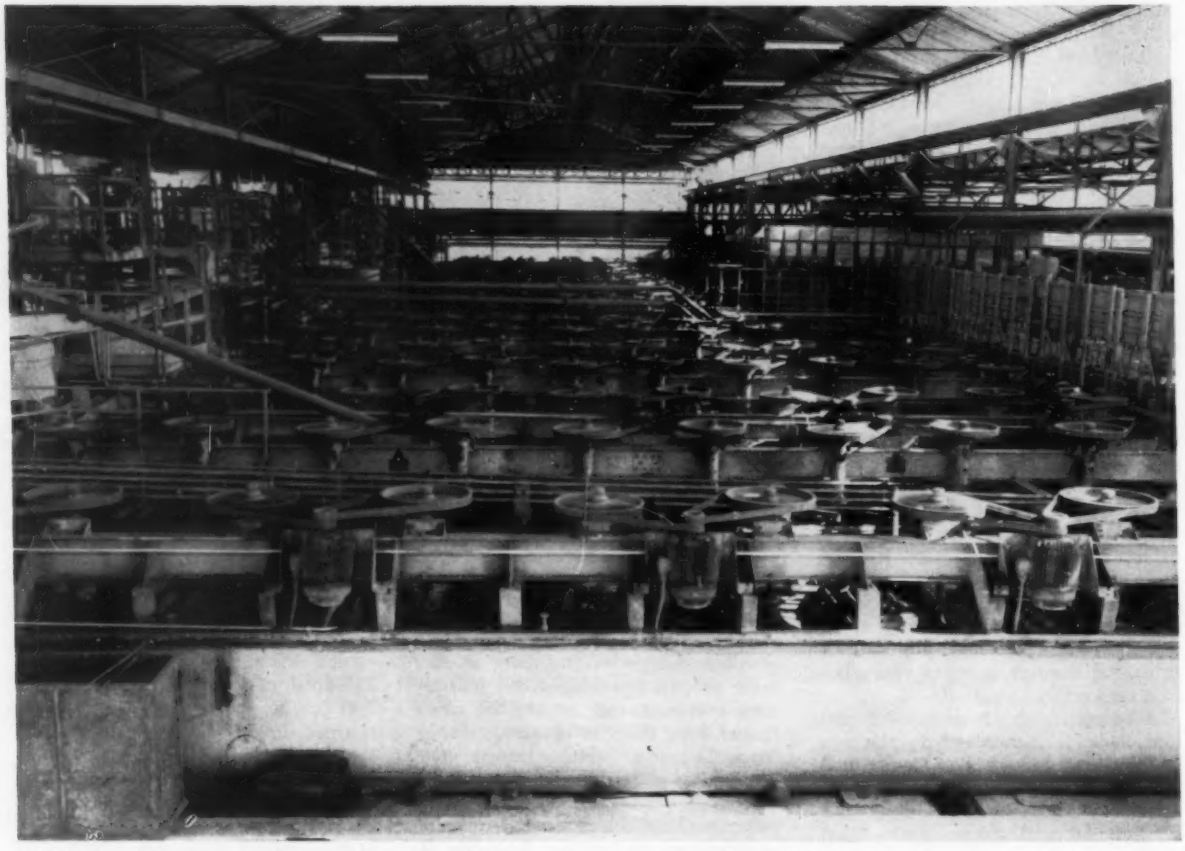
KIPUSHI OREBODY showing level and hoisting and ventilation shafts.

The first pump station was on the 135 level; others are on 240, 350, and 500 levels. Each pump system discharges directly to the surface. During the process of lowering the water level from the 350 to the 500 level, the water inflow surpassed 50,000 cubic meters, or 13,500,000 United States gallons per day. Now the pumps on 500 level still exhaust nearly 33,000 cubic meters, 9,000,000 gallons, per day. This system is equipped with six 550-cubic-meter-per-hour water pumps (equal to 2.400 US gallons per minute) of 530m manometric height and driven by a 1.900-horsepower motor.

The Kipushi mine produces direct smelting copper ore containing at least 20 percent copper. Mill ores contain 2.0 percent plus copper and are treated at the mine by a selective copper, zinc flotation mill. The direct shipping ore and the copper concentrate go to the Lubumbashi copper smelter near Elisabethville. The zinc concentrate is calcined at Jadotville by SOGECHIM which supplies Union Minière with sulphuric acid. The calcine is treated at Kolwezi by METALKAT which produces electrolytic zinc.

The Prince Leopold mine, on the average, employs a total of 200 Europeans and 3,600 natives. Some 90 Europeans and 2,200 natives work underground. The remainder work at the concentrator, in the maintenance and repair shops, in supply stores, in health stations, hospitals, and all those organizations which provide for the material and moral needs of the native workers and their families.

THE END



KOLWEZI CONCENTRATOR treats oxide, sulphide and mixed oxide-sulphide ores containing copper and cobalt in Denver and Agitair flotation machines shown above. Oxides are floated using a hydrolyzed palm oil collector.

1906
1956

Kolwezi Mill Concentrates Three

Concentration of some of the complex copper and cobalt ores near Kolwezi is extremely difficult and required a great deal of original work by Union Miniere to develop efficient milling methods. This was particularly true because the ore bodies occurring in the western district are so unlike other developed mines in the world today. So far, attempts at differential concentration of copper and cobalt has been unsuccessful. The assemblage of both ore minerals and gangue minerals quite largely determines milling procedure. In general, the following three classes of ore are treated separately at the Kolwezi concentrator.

1. Oxide copper containing a minor amount of cobalt.
2. Cobalt-copper oxide ore containing approximately equal values of the two metal constituents.
3. Mixed ore which contains both cobalt and copper oxides and cobalt and copper sulphides.

The slightly cobaltiferous copper-ore deposits of the Katanga province are located in formations that can be subdivided into three categories which are: the upper deposits, in the neighborhood of the surface and above the hydrostatic level; the lower deposits below the hydrostatic level; and the intermediate deposits lying within the hydrostatic level. The upper part of the deposits includes ores with altered gangue, resulting from the decomposition of the limestone and dolomitic schists. The mineralization is predominantly malachite ($Cu_2(OH)_2CO_3$), pseudo-malachite, chrysocolla (CuO, SiO_2,H_2O), and heterogenite (CoO $2Co_2O_3$ $6H_2O$), and cobaltiferous wad. Deposits of both copper and copper-cobalt are found in the upper formations.

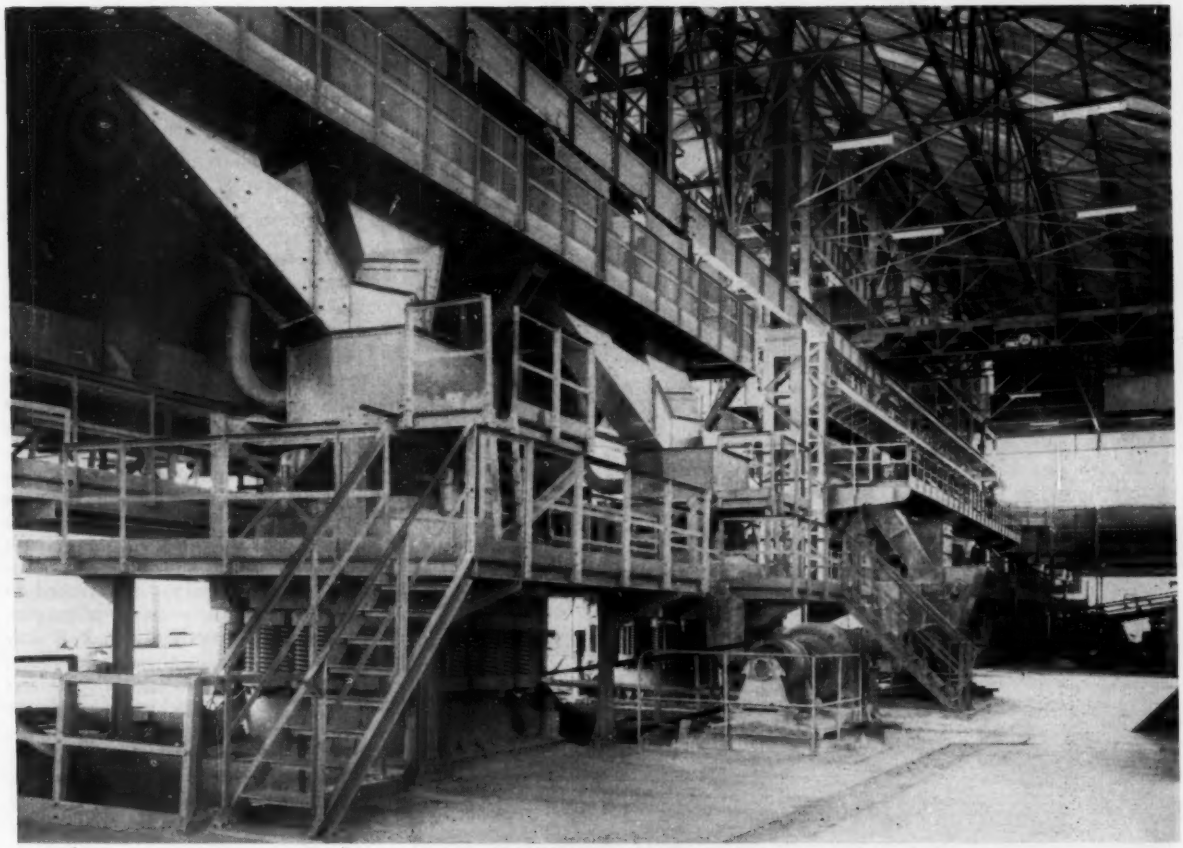
Grade and Recovery of Typical Copper-Cobalt Oxide Ore at Kolwezi Mill

	Copper		*Cobalt*	
	Content (Percent)	*Recovery (Percent)*	*Content (Percent)*	*Recovery (Percent)*
Feed	2.31	100.00	2.06	100.00
Cleaned concentrate	10.40	82.20	7.90	70.10
Rougher tail	0.50	—	0.75	—

Selective mining is practiced in the upper formations so that different classes of ore can be treated separately. Concentration of the copper oxide ore is very well developed and needs little explanation. This ore contains 5 to 6 percent copper and 0.2 to 0.3 percent cobalt, and is floated in a well dispersed pulp with hydrolyzed palm oil. Dispersents used are sodium carbonate and sodium silicate. The concentrate assays 26 to 27 percent copper and about 1 percent cobalt. The recovery of copper is 82 to 85 percent.

Sulphide Flotation

In the lower deposits, typical sulphide ores are found. The gangue is a siliceous-dolomitic rock and mineralization is composed principally of



SECONDARY CRUSHERS pictured above are Symons gyratory machines at Union Minière's Kolwezi mill. Copper-cobalt ore from the western group of mines is reduced to ¾ inches in size before it is delivered to the grinding section.

Types of Copper-Cobalt Bearing Ores

chalcocite (Cu_2S) and minor amounts of bornite (Cu_4FeS_3) and chalcopyrite ($CuFeS_2$). The chief cobalt minerals found is carrolite ($CuS\ Co_2S_3$). The flotation of this 5 percent copper and 0.1 to 0.2 percent cobalt sulphide ore is rather easy. After grinding has liberated the fine chalcocite speckles, the ore is floated in an alkaline circuit using xanthate and a frothing agent. The concentrate assays 45 to 60 percent copper, according to the chalcocite dissemination in the ore, and 0.5 to 2 percent cobalt. Recovery of the two metals is 80 to 82 percent.

Some chalcocite-carrolite selectivity can be obtained by adjusting the pH of the circuit with controlled addition of milk of lime. Treatment of mixed oxide-sulphide ore is described later in this report.

Copper-Cobalt Ore

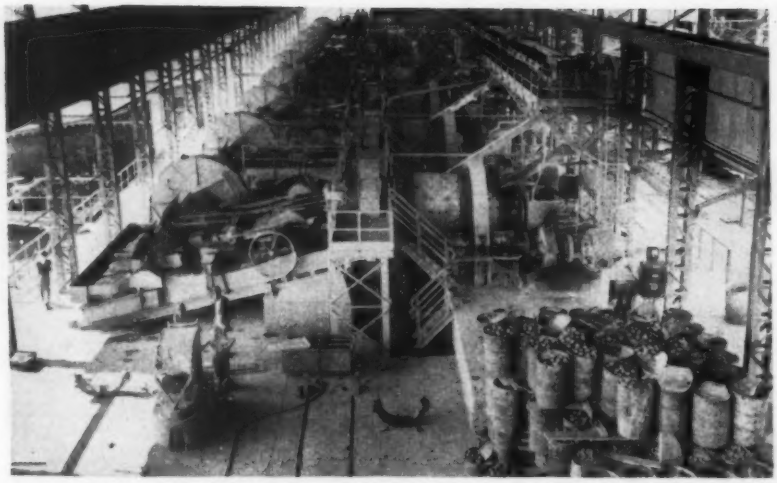
Selective mining at the open pits at Musonoi and Kamoto makes possible the extraction of the cobalt-copper oxide type of ore. This ore makes up about 8 to 10 percent of the total oxide ore available for concentration. The gangue is similar to that found with the oxide copper ore, and is composed of argilaceous or siliceous schists. The ore, to be classified as copper-cobalt oxide, should assay more than 1.7 percent cobalt and less than 3.5 percent copper. This feed is treated during separate campaigns in the Kolwezi concentrator at periodic intervals.

The flowsheet includes primary and secondary crushing by a jaw crusher and a cone crusher to ¾-inch size. An Allis Chalmers, Blake-type jaw crusher is used at the plant. Due to the soft nature of the ore it is not possible to crush finer than ¾-inch without the danger of clogging the cone heads. Grinding is carried out in a rod mill which operates in open circuit and feeds three, rake classifiers, which are in closed circuit with three ball mills. Fine grinding results in a pulp which screens 10 to 15 percent plus-65-mesh and 60 to 65 percent minus 200-mesh. The soft ores exhibit a tendency to slime.

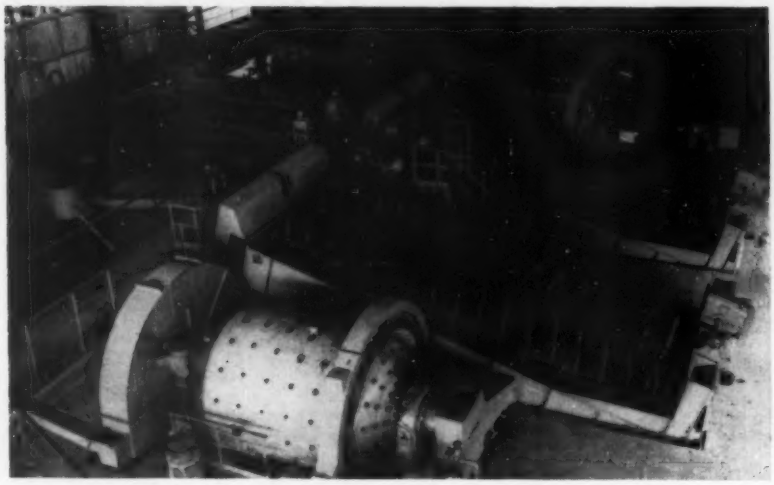
Reagent Consumption During Copper-Cobalt Oxide Treatment Campaigns At Kolwezi Mill

Reagent	*Consumption in Kilograms Per Metric Ton*
Sodium silicate	0.35
Sodium carbonate	0.55
Palm Oil (Hydrolyzed)	1.20
Tall Oil	0.06

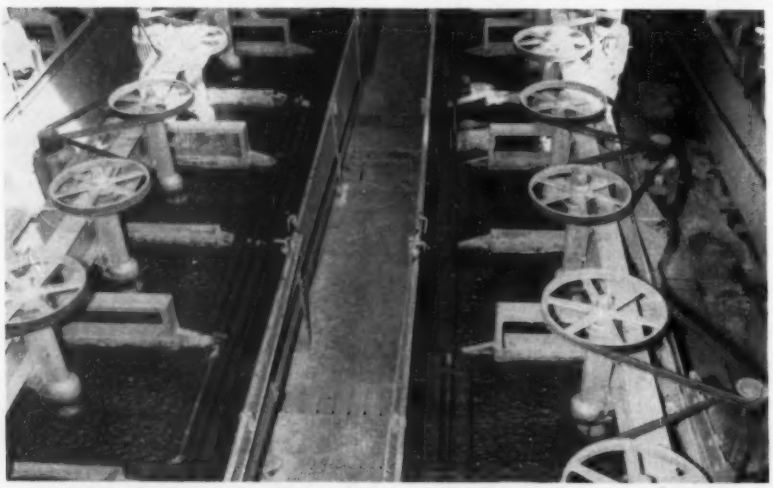
The flotation of copper-cobalt oxide ore is carried out by using a 60 percent hydrolyzed palm oil as a collecting-frothing reagent to which a dose of about 5 to 7 percent tall oil is added. The latter reagent increases the frothing power of the mixture. After the grinding operation the pulp is conditioned with sodium carbonate and sodium silicate in order to deflocculate and disperse the gangue. The available water is very soft and flotation is carried out at a temperature of 19 to 23°C.



WESTERN ORE treated in the Kolwezi concentrator is ground by rod mills which are in open circuit followed by Hardinge 8-foot by 48-inch ball mills in closed circuit with Dorr rake classifiers.



GRINDING SECTION for circuit treating mixed oxide-sulphide ore containing copper and cobalt is shown above. This section consists of four Hardinge, Tricone ball mills and four Akins (Colorado Iron Works), 78-inch classifiers.



RECOVERY of copper and cobalt in Denver flotation machines is seriously influenced by the degree of ore-mineral impregnation in the gangue; by the presence of slimes produced during grinding and by the mineral assemblage.

Typical Analysis of Mixed Oxide-Sulphide Ores Treated at Kolwezi Mill

Material	*Percent*
Total Copper	4 to 6
Total Cobalt	0.2 to 0.3
Copper oxide	1.5 to 4
Cobalt oxide	0.15 to 0.25
Calcium oxide	3 to 10
Magnesia	4 to 8

Collector is Emulsified

Before being added to the ore pulp, the palm oil is emulsified in a colloid mill. The emulsion is stabilized as a sodium soap compound, at the moment of dispersion, by reaction of the fatty acids of the palm oil with the sodium carbonate added in the wet phase.

The flotation flowsheet is simple. Roughing is done in 10-cell flotation machines; cleaning and recleaning is carried out in 6-cell machines (4 cells for cleaning and 2 cells for recleaning). Recleaner tailing is returned to the roughers. The recovery of copper, and more particulaly of cobalt, is seriously influenced by the degree of impregnation of ore minerals in the gangue; by the production of slimes during grinding; and by the presence of difficulty floatable minerals such as heterogenite, light black oxides and chrysocolla. Therefore, the grade of concentrate and recovery is not very high on the copper-cobalt oxide ores.

The flotation concentrate is thickened following the addition of sulphuric acid to adjust the pH to 7.2. Neutralization reduces the dispersing effect of sodium silicate added at the conditioners. The thickened concentrate is filtered on a vacuum drum filter. The pulp is heated to 50 to 55° C. to increase filtration capacity and to make the filter cloth more resistant to blinding. After sintering, the cobalt-copper oxide concentrate is treated by electric, reduction-smelting to produce a white alloy containing 42 to 45 percent cobalt and a red alloy containing 90 percent copper and 5 percent cobalt. The flotation tailing is stockpiled and will later be treated in a leaching electrolytic plant now under construction near Kolwezi.

Grade of Concentrate and Ore and Recovery of Minerals From Mixed Oxide-Sulphide Ores Treated at Kolwezi Mill

	Copper		*Cobalt*	
	Content (Percent)	*Recovery (Percent)*	*Content (Percent)*	*Recovery (Percent)*
Feed	6.00	100.00	0.24	100.00
Sulphide Concentrate	46.20	46.70	0.45	11.20
Oxide Concentrate	19.00	34.40	0.76	34.00
Total Recoveries	—	81.10	—	45.20
Roughing Tailing	1.35	—	0.16	—

Typical Reagent Consumption in Circuit Treating Mixed Oxide-Sulphide Ores At Kolwezi Mill

Reagent	*Consumption (Kilograms Per Metric Ton)*
Sodium silicate	0.150
Pine Oil	0.070
Ethylxanthate	0.080
Sodium Sulphhydrate	1.200
Amylxanthate	0.050
Tall Oil	0.010
Gasoil	0.100
Rods	0.200
Balls	0.600
Energy Kilowatt-hours per ton	26.00

The mixed ores (sulphides and oxides), which are found in abundance in the Western mines, mark the transition between the oxide mineralization of the surface and the sulphide mineralization found at depth. The mixed ores are in general definitely dolomitic. The oxide mineralization is principally composed of malachite with accessory chrysocolla; sulphide mineralization is principally chalcocite. Both oxide and sulphide mineralization is very finely disseminated; chalcocite speckles often do not exceed a few microns in size. These ores usually contain accessory cobalt (0.2 to 0.3 percent cobalt) which generally occurs in the oxide form. The ore will contain 4 to 6 percent copper.

A great deal of research was required to discover an adequate method to treat the mixed ores. The following operating process was finally adopted after a thorough study had been made.

- **Grinding to moderate fineness of the ore (70% at -200 mesh);**
- **Flotation of the chalcocite by xanthates and frothing agents;**
- **Flotation of the malachite by superficial sulfidization by means of an alkaline sulphhydrate sulphide and collection with a xanthate;**
- **Regrinding and reflotation of the sulphide middlings.**

The treatment of the oxide portion of the ore following sulphide flotation is very complicated. The phenomenon of sulphidization is not too well understood, and it is necessary to stage-add the alkaline sulphhydrate to practically every cell of the flotation machines in this circuit. In addition higher xanthates (amyl) are needed to obtain good recovery. Close control must be exercised over the frothing characteristics by the judicious addition of starvation quantities of an emulsion composed of gas oil and palm oil.

Flowsheet

The grinding and flotation of the mixed ores is carried out in a special

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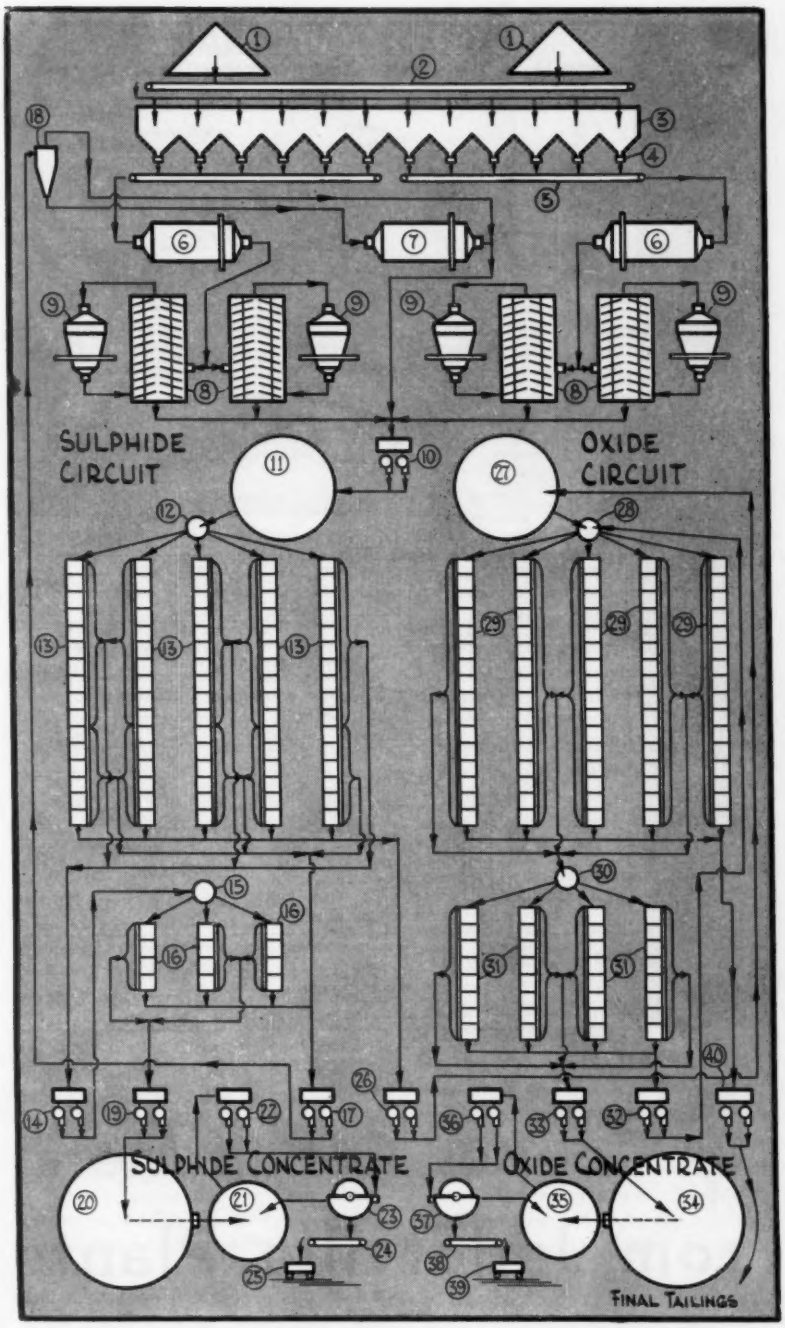


LEGEND

GRINDING-CLASSIFICATION

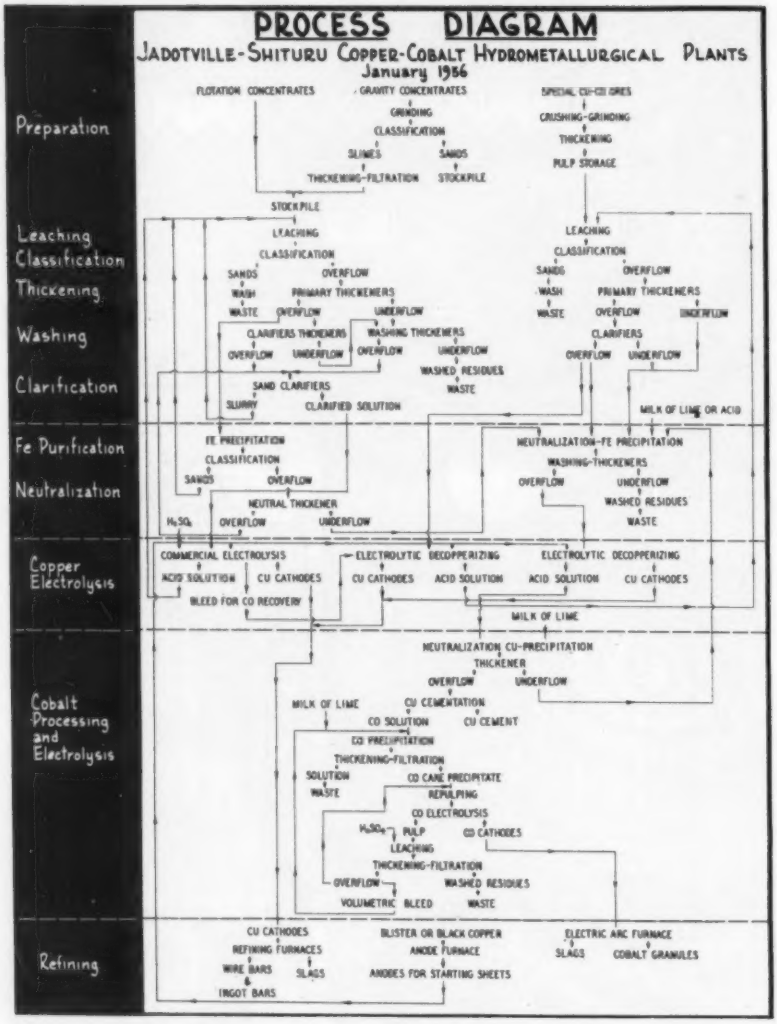
1. 1,000-ton stockpile of crushed ore.
2. Conveyor belt, 30-inch.
3. Two 1,000-ton ore bins.
4. 12 vibrating feeders, 30- by 55-inch.
5. Conveyor belt, 20-inch.
6. Rod mill, 7- by 12-foot.
7. Tube mill, 7- by 12-foot.
8. Akins duplex spiral classifier.
9. Tricone ball mill, 9-foot.
10. Wilfley pumps, 8-inch.

SULPHIDE CIRCUIT

11. Conditioning tank, 30- by 8-foot.
12. Pulp distributor.
13. Denver "Sub A" flotation machines.
14. Wilfley pumps, 4-inch.
15. Pulp distributor.
16. Denver "Sub A" flotation machines.
17. Wilfley pumps, 4-inch.
18. Cyclone.
19. Wilfley pumps, 3-inch.
20. Thickener, 40-foot-diameter.
21. Storage tank.
22. Wilfley pump, 4-inch.
23. Eight-disc filter, 8½-foot.
24. Belt conveyor, 20-inch.
25. Truck.

OXIDE CIRCUIT

26. Wilfley pumps, 6-inch.
27. Conditioning tank, 30- by 8-foot.
28. Pulp distributor.
29. Denver "Sub A" flotation machines.
30. Pulp distributor.
31. Denver "Sub A" flotation machines.
32. Wilfley pumps, 4-inch.
33. Wilfley pumps, 6-inch.
34. Thickener, 40-foot-diameter.
35. Storage tank.
36. Wilfley pumps, 4-inch.
37. Two, eight-disc filters, 8½-foot.
38. Conveyor belt, 20-inch.
39. Truck.
40. Wilfley pumps, 8-inch.



Copper, Cobalt Metal From Jadotville Plants

With both copper and cobalt in solution, electrolysis plates out copper . . . cobalt electrolysis requires complex purification

By THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

At the great Jadotville-Shituru plant, a double electrolysis is employed to recover both copper and cobalt from acid-leached copper-oxide concentrates and ores. Solving the complex metallurgical problems was certainly one of the outstanding achievements of the Union Miniere staff. Hydrometallurgical treatment of Katanga oxide ore is growing in importance and is being applied to mixed sulphide as well as oxide feed. Also a new leaching and electrolytic plant is being built near Kolwezi and should be ready in 1959.

The Jadotville plants constitute the most important industrial group of the Belgian Congo, and consist of the following installations:

1. Copper and cobalt, leaching and electrolysis plants plus adjoining refineries for these metals.
2. A lead plant for producing anodes for electrolytic tanks.
3. The Panda electric smelter where white (blanc) alloy containing 46 percent cobalt is produced.

The feed for the Jadotville metallurgical center is produced from the Western group of mines in the vicinity of Kolwezi. Cobalt occurs in several different classes of ore. Some of the deposits, such as those at Musonoi and Kamoto contain oxidized ore in the upper levels where the cobalt content may locally reach 6 to 8 percent. Another type of ore carries 1.5 to 2 percent cobalt, and is concentrated by washing-jigging or palm oil flotation to 7 to 8 percent cobalt. These high cobalt bearing products are smelted and reduced in electric arc furnaces which turn out the complex white alloy. The white alloy is exported and refined, either in Belgium or the United States, to produce commercial cobalt. About 44 percent of the cobalt output of Union Miniere is obtained from the Panda electric furnace operation.

Low Grade Cobalt

The greater part of the company's reserves of cobalt consist, however, of oxidized copper ore or mixed or sulphide copper ore, containing less than 0.5 percent cobalt. On being concentrated for copper, most of the cobalt passes into the concentrate. No differential flotation process has yet been developed to produce a copper concentrate free of cobalt or a cobalt concentrate low in copper.

It is the oxide concentrates that are now supplied to the electrolytic plant at Jadotville. The sulphide con-

centrates will in the near future be given a sulphate roast and then leached along with oxide concentrate in the projected new Kolwezi plant. The Jadotville-Shituru plants now have an annual capacity of 115,000 to 117,000-long-tons of copper wire-bars and 5,500-tons of cobalt granules; the latter works will be enlarged this year to attain a capacity of 125,000 to 130,000 tons of wire-bars.

In 1959 the new hydrometallurgical plants of Kolwezi-Luilu will be started. This installation is designed for a production of 100,000-tons-per-year of wire-bars and 3,500-tons of cobalt annually. This output can readily be expanded to 150 percent of presently planned production.

Both plants are the result of extensive work in the research department of Union Miniere. The copper metallurgy and the cobalt metallurgy of the Jadotville electrolytic plant are discussed separately.

A GREAT HYDROMETALLURGICAL CENTER, the Jadotville-Shituru plant turns out over half the copper and cobalt produced by Union Miniere. Adjoining Panda unit recovers remainder of cobalt in form of white (46 percent) cobalt alloy.

THE JADOTVILLE-SHITURU PLANTS

Copper Production

The 1929 erected Shituru plants were originally projected for the treatment of difficultly concentratable ores and for a 30,000-ton copper production per year. However, progress in flotation methods with palm oil changed the picture somewhat and today the following three types of feed are treated in the plant.

1. Malachite concentrate obtained by flotation.
2. Washing plant gravity concentrate.
3. Special copper-cobalt ore to increase cobalt production.

The principal raw material fed at Shituru is composed of malachite concentrates, which are fed at a rate 30,000 to 32,000 dry tons per month. The ores from which they originate are strongly alterated and the concentrates still contain a certain quantity of primary slimes of a more or less colloidal character. This characteristic has necessitated the use of equipment different from normal clarification machinery and methods used in the United States.

To get the metal in the concentrates into solution, pneumatic agitating vats of the Pachuca type are used. They assure a longer contact and continued agitation of the particles in the acid solution.

The nature of the products makes it necessary to subject the pulp which comes from the leaching plant to the treatment outlined below:

1) To a classification to get rid of the sand and so avoid breakage of the thickener mechanism;
2) to a decantation;
3) to a very careful clarification so as to obtain a solution free from particles in suspension.

This is absolutely necessary to assure a satisfactory yield during the subsequent electrolytic operations.

The section for decanting and clarifying the pregnant solution is particularly well developed at Shituru and comprises, at present, an assembly of clarification equipment and washing decanters.

Formerly, flocculation of the leach residue was performed either with glue or with manioc starch obtained by warm causticizing of local manioc flour. Today thickening is considerably improved by the use of natural or artificial organic flocculating reagents, such as Guartec, Jaguar, Separan and Aerofloc.

The action of the clarifying thickeners must be completed by passing the solutions through filter beds which are formed by layers of gravel. This latter procedure was finally adopted after fruitless tests with numerous other methods. Actually the solids content of the solution fed to the tank house is from 0.10 to 0.15 grams-per-liter.

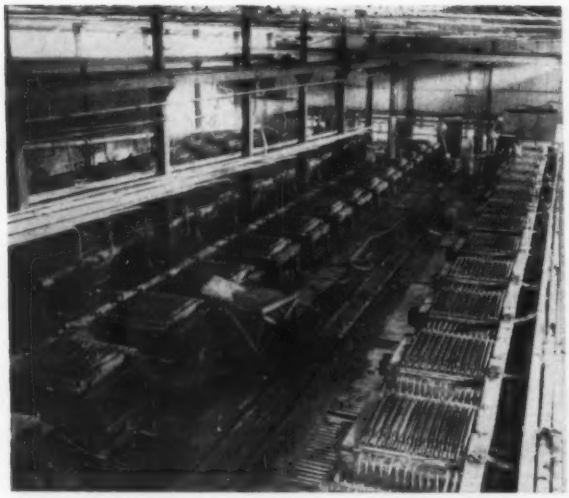
Cell Construction

A second problem was created by the presence of iron in the solution sent to the electrolytic tank room. Iron causes a reduction in the current efficiency and has made it necessary to add a special section for its partial elimination. This is done by neutralizing part of the solution with a sandy, malachite concentrate; the presence of phosphoric acid enables the precipitation of iron, at a low pH (2.2 to 2.5), as ferric phosphate. The sandy character of the precipitating base results in phosphate flakes with rapid settling and thickening characteristics.

The rest of the electrolytic treatment of the copper hardly requires special comment with the exception of a few remarks about the construction of the electrolytic tanks. The cells are unusually long, measuring 65 feet, but this has presented no particular problems. Alumina brick is gradually being substituted for the use of mastic linings in the concrete tanks. The alumina bricks have demonstrated an excellent resistance to corrosion, and maintenance requirements have been negligible. On the other hand, mastic linings did not resist high temperatures of 58 to 60° C. which resulted from the high operating amperages of 200 to 220-amperes-per-square-meter.

At present the tank room is equipped with 160 tanks, each having 201 anodes and 198 cathodes, for commercial electrolysis; the starting sheets section with its 176 tanks is completely independent and can produce from 12,000 to 18,000 tons of copper yearly. The accompanying graph shows copper cathode production of the Shituru plants as well as cobalt production.

Copper cathodes are refined on the spot. They are recast to be molded into wire bars or into ingot bars in three 200- to 220-ton reverberatory, refining furnaces fired with pulverized



COBALT ELECTROLYSIS is shown at the left. The electrolyte is actually a solution of cobalt which is neutralized with cobalt hydrate slurry. At the right a section of the copper tank house is shown. Alumina brick lining is being used in increasing amounts in these cells. Yearly electrolytic copper output is 125,000 tons.

coal. The casting is done on Clark machines.

Cobalt Production

The concentrates that form the feed of the copper leaching plant also contain cobalt. Contrary to copper-oxides, the cobalt-oxides are only slightly soluble in sulphuric solutions, when not in the presence of a reducing agent. The reducer chosen is ferrous sulphate contained in the solutions returned to the leaching circuit.

The conditions for electrolysis of copper maintains in these solutions a ferrous-ferric ion equilibrium which makes possible the solution of 200- to 300-tons of cobalt a month. The dissolution of cobalt is practically complete. Inasmuch as the cobalt is not deposited with the copper, the solutions enrich themselves in cobalt until they reach an equilibrium concentration. At this point some of the cobalt rendered soluble would be rejected in washing the leach residue.

In order to avoid this solution loss, an important quantity of wash water is added at the end of the washing-thickener chain. To maintain the volumetric balance of the circuit, a solution bleed is operated at the exit of the copper electrolysis hall. The free acid of this bleed and the acid regenerated during the copper electrolysis is used to leach, in a separate circuit, copper-cobalt ores with a low Cu-Co yield. These ores are not amenable to concentration.

The treatment of second hand copper-cobalt ores permits precise control of the amount of cobalt added to the circuit, thus regulating production. Dissolution of cobalt contained in these ores is improved by adding some pulverized copper obtained by electrolysis and by maintaining a sufficient iron sulphate concentration.

Double Electrolysis

A characteristic of cobalt recovery, from ore and bleed, is the way in which the cobalt-bound copper is recovered. Two types of solution are electrolyzed to extract most of the soluble copper. First the 25 to 30-gram-per-liter solution of copper in the tank house bleed is mixed with some solution obtained by leaching ores and then treated by electrolysis. Second, solution from ore leaching is electrolyzed separately. The pulp resulting from leaching ore is neutralized with lime to a pH of 3 to 3.5 to precipitate iron and alumina.

The precipitates as well as the gangues are separated from the solution by decantation and counter-current washing. The clear, decanted solution, containing 8-grams-per-liter of copper, is electrolyzed to lower the copper content to 1.5-grams-per-liter. This electrolysis, and that of the bleed solution from the tank room, necessitates an energetic agitation of the bath to obtain desirable current efficiency and good cathodes. The solution at 5-grams-per-liter in copper returns to the ore leaching section; the 1.5-gram-per-liter solution of copper is neutralized again by milk of lime to a pH of 5.8 which reduces the remaining copper content to about 0.1 grams per liter.

This latter operation is carried out in a series of Pachucas. The Pachuca pulp is thickened to separate solution from precipitate; the precipitate returns to the neutralization and iron precipitation section. The solution is contacted with beds of annealed metallic cobalt granules where the last traces of copper are removed. The solution will then only contain cobalt, a little iron, nickel, zinc, manganese and magnesia.

Cobalt Electrolysis

A second treatment by milk of lime in agitation machines yields a precipitate containing cobalt. This precipitate is supplied to the cobalt electrolysis section. Inasmuch as the cobalt is an electronegative product, electrolytic deposition of the metal is only possible in a neutral solution. This is achieved by electrolyzing a pulp containing cobalt-hydrate in suspension.

The cobalt-hydrate acts as a neutralizing agent for the acid that has been liberated by the cathodic deposit. The harmful effect of the solids in the electrolyte, which amount to about 70-grams-per-liter, is avoided by an intense agitation in the electrolytic cell. Agitation is obtained by the introduction of an airflow through specially designed anodes. Another advantage of the agitation is that it aids the reaction of the hydrates of cobalt with the acid. Consumption of energy during electrolysis amounts to 6.5 kilowatt-hours per kilogram of cobalt at a current density of 500-amperes-per-square-meter.

Cobalt cathodes are refined in a 1600-kilovolt-ampere, triphase, electric-arc furnace. This refining, similar to the operation applied in the production of extra mild basic steels, permits a slightly oxidizing fusion which scorifies the manganese as well as a desulphurization by a reducing slag of a high lime content. The zinc, volatilized in large part at the beginning of the operation, is completely

eliminated by a poling. The liquid cobalt is then granulated in water and polished for export. The company's production of electrolytic cobalt amounts to 5,600 tons per year.

FUTURE KOLWEZI-LUILU PLANTS

In order to increase its electrolytic production of copper and cobalt, Union Miniere will complete in 1959, an important hydrometallurgical and thermical complex offering some important innovations compared with the Jadotville-Shituru Plants.

The flow-sheet of these plants is shown with this report. The following principal peculiarities should be noted: Copper-cobalt feeding material will be of two different kinds; a malachite concentrate, obtained by palm oil flotation of surface oxide ores, will be treated along with a chalcocite concentrate obtained by xanthate flotation of mixed or sulphide ores found in the lower levels of our deposits.

The chalcocite concentrate (containing a little cobalt in carrolite form) will be sulphate-roasted to transform the copper and cobalt sulphides into soluble sulphates, leaving the greater part of iron in poorly-soluble, oxide form. The sulphate calcine will be repulped with some acid solution and this calcine as well as the malachite or oxide concentrate will be treated by double acid and neutral leaching.

Differs from Shituru

Due to the sulphate roast and subsequent regeneration of acid during electrolysis, an extremely low acid consumption will be attained at the Luilu plant. It is expected that acid consumption at the latter facility will be 180 kilograms per ton of cathode copper compared to actual consumption of 375 kilograms per cathode ton at Shituru.

Composition of Cobalt Cathodes at Jadotville-Shituru Plant Of Union Miniere Du Haut Katanga

Cobalt	92 to 94 percent
Nickel	0.25 to 0.30 percent
Iron	0.05 to 0.08 percent
Copper	0.01 to 0.03 percent
Manganese	0.1 to 0.3 percent
Zinc	1 to 1.8 percent
Sulphur	0.1 to 0.3 percent

The leaching-classification-thickening-washing section of the projected Luilu plant will be similar to the Shituru plant. However, it should be noted that leaching in Pachucas will be given up and that mechanical agitators with a central airlift will be substituted. Also the practice of purifying the leach solution by neutralizing iron with sandy malachite concentrate will be abandoned at the new plant. Instead a copper hydrate precipitate obtained from neutralized bleed copper solution will be used.

The neutralization with iron precipitation of the cobalt-bleed will be carried out by treating the solution with milk of lime in mechanical agitators set in series; after thickening the lime-sulphate and iron-hydrate and phosphate will be filtered on a horizontal filter.

Generally speaking cathode cobalt production will be similar to the same techniques applied at the Shituru plant with this important exception. The volumetric balance in the new plant will be attained by the use of an evaporator of the "heating pump" type rather than by a solution bleed.

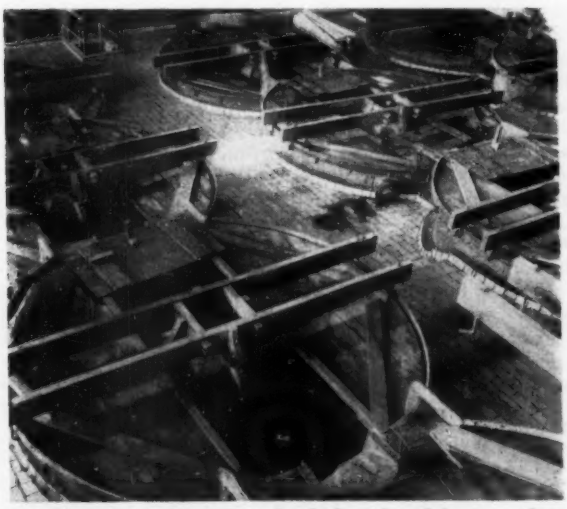
When the new Kolwezi-Luilu plant is in service, Union Miniere will be able to produce 200,000 to 210,000 tons of electrolytic copper per year. This compares with the present annual production of 140,000 tons of electrolytic copper per year. Electrolytic cobalt production should grow to 8,500 to 9,000 tons per year compared to the present 5,600 tons. Output of cobalt granules could easily be expanded to 11,000 or 12,000 tons each year.

PANDA SMELTER

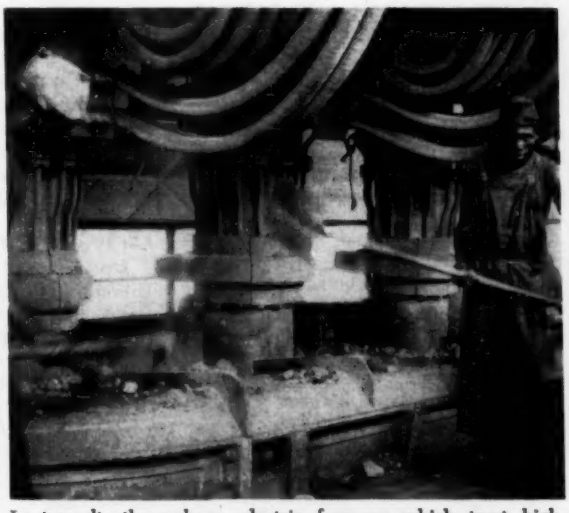
The richer cobalt ores and the sintered cobalt concentrates from the Kolwezi concentrator are treated in three tri-phase furnaces. Two are 2,000-kilovolt-amperes and one is a 3,000-kilovolt-ampere furnace. There is also a fourth, single-phase, 700-kilovolt-ampere furnace. By melting the charge in a reducing atmosphere, the cobalt, copper and iron are released in a liquid form.

By difference of density, the liquid metals separate into two layers. The red alloy, rich in copper and poor in cobalt, is treated right in the plant itself. The white alloy, rich in cobalt and iron but still containing 15 percent copper, is sent to the Olen plant in Belgium or to the United States for separation of cobalt and copper.

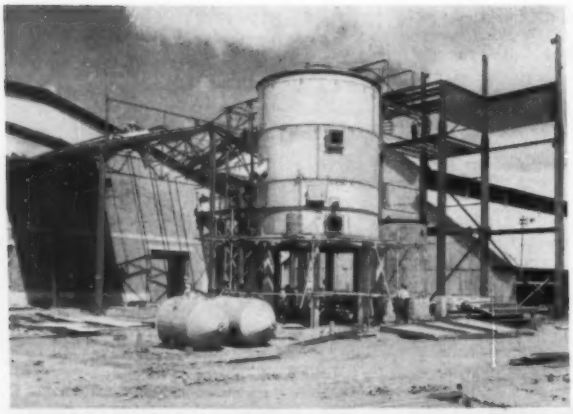
The Panda smelter capacity averages nearly 4,000-metric-tons of cobalt content per year. The electric furnaces are also used in campaigns to obtain crude copper from the oxide ores. This copper is subsequently pre-refined in a rotary furnace at the same time as the red alloy. The 98.5 percent pure metal so obtained is refined and cast into anodes at the Shituru plant. These anodes are used to produce starting cathode sheets for the Shituru tank room. **THE END**

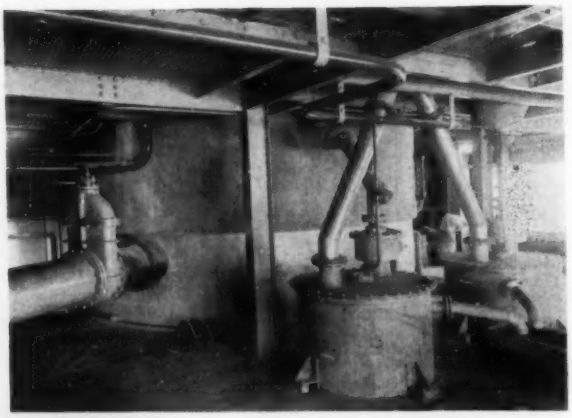


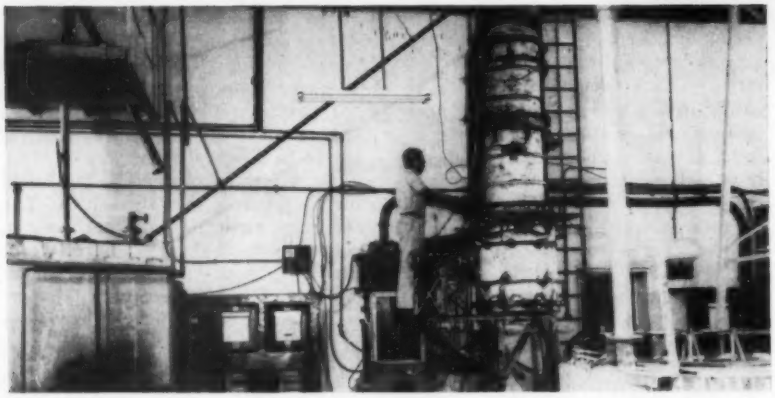
COPPER-COBALT ORE is leached with sulphuric acid in Pachucas shown in the picture at the left. Cobalt is soluble only under reducing conditions. At the right is one of the Pittsburg



Lectromelt, three-phase, electric furnaces which treat high-grade cobalt ore and concentrate, and produce a white alloy and red alloy for further processing.







FLUOSOLID ROASTING in Dorr reactors has proven to be the key to treating copper-cobaltiferous sulphides. Sulphate roasting by the fluidized process is not adversely affected by agglomeration; in addition an important quantity of sulphate is available for production of make-up sulphuric acid during leaching. A new plant is being constructed at Kolwezi to process chalcocite concentrates. At upper left, a fluosolid roaster is shown under construction at Jadotville. Picture at upper right shows how the roasted sulphate calcines are discharged into quench tanks. At lower left, a veiw of the pilot plant is shown where methods of treating cobalt-bearing, chalcocite concentrates were studied.

1906
1956

Why Fluidized Roasting Is The Answer To Refining Chalcocite Concentrates

By THE RESEARCH AND TESTING DEPARTMENT OF UNION MINIERE

Early in 1956 a Dorr Fluosolids reactor was installed at the Jadotville-Shituru leaching section to perfect sulphate roasting of copper-sulphide concentrates on an industrial scale. The development of economical methods for recovering copper and cobalt from sulphide concentrate is important because large reserves of sulphide ore exist at depth in the western group of mines.

Previous test work has indicated that the fluidized roasting method offers several attractive economies. For one thing a favorable heat balance exists and no external source of heat is required to maintain the roast reaction. Hearth-roasting tests resulted in an unfavorable heat balance due to agglomeration of the ore at relatively low temperatures. In addition tests with fluidized roasting resulted in the production of up to 208 kilograms of available sulphur for sulphuric acid per ton of crude concentrates. Acid regenerated from electrolysis of copper sulphate solutions can of course be used in the existing leaching facilities for oxide ore and concentrates at the Jadotville-Shituru plants.

Large Sulphide Reserves

Up till recently, the exploitation of Union Miniere's western deposits in the Katanga was chiefly confined to mining the surface oxide ores and mineralization consisted chiefly of malachite ($CuCO_3 \cdot Cu(OH)_2$). This ore is floated using palm oil fatty acids or soaps and the malachite concentrate is treated in the leaching-electrolytic plant where both copper and associated cobalt are recovered. The leaching method is a big acid consumer and the chemical loss reaches 35 to 40 kilograms of acid per ton of oxide concentrate. To this must be added the cobalt-bound sulphate and the acid lost by the recovery of the solutions.

Reserves of oxide ore are substantial, but deeper penetration of the Union Miniere deposits will yield more and more mixed ores (sulphides and oxides) and sulphide ores. The sulphide ore contains copper in the

Analysis of Products From Fluidized Roasting of Chalcocite Concentrate

Product	*Percent Weight*	*Percent Copper*	*Percent Sulphur total*	*Percent Sulphate*
Overflow calcine	97.2	38.53	10.82	10.77
Cyclone dust	2.8	26.43	10.85	10.25
Total calcine	100.0	38.19	10.82	10.76

form of extremely finely divided chalcocite (Cu_2S) and is accompanied by a dolomitic gangue. Generally the ore carries accessory cobalt as carrolite ($CuS\ Co_2S_3$). Xanthate flotation yields concentrates with analyses shown in the accompanying table.

Smelting Unfeasible

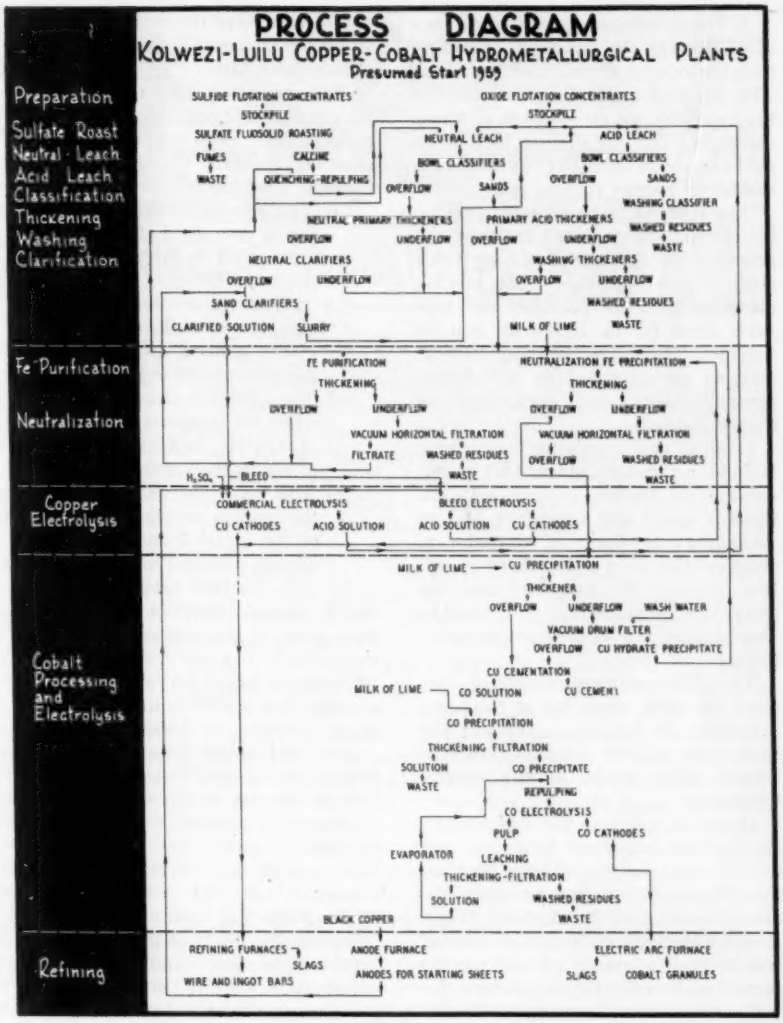
It is out of the question to treat chalcocite concentrates in the existing Jadotville-Shituru, leaching-electrolytic facilities. Copper and cobalt recovery would have been low even by applying leaching with strong ferric sulphate concentration (which moreover is harmful to copper electrolysis). In addition the dolomitic gangue would evolve carbon dioxide and the gaseous release would be harmful to thickening and clarification of circulating solutions.

The application of dry metallurgy was seriously considered. This treatment would have included: direct electric smelting of sulphide flotation concentrate with quicklime to form a white matte and a low metal bearing slag; converting of the matte for production of blister copper and a cuproferro-cobaltiferous-slag; remelting of the copper in soluble anodes and electrolytic refining for finished copper; reduction-smelting of the converted slag to obtain an white alloy of cobalt and a copper, red alloy; and refining of the white alloy in Belgium or the United States for finished cobalt. The examination of the economic aspects of the above methods appeared unsatisfactory.

Next, it was planned to submit the sulphide flotation concentrate to a sulphating roast and to dissolve the calcine in the leaching section of the Jadotville-Shituru plant which is now treating copper oxides. The copper and cobalt would both pass into solution and the cobalt could be recovered by a bleed of the circulating solution. Copper could be recovered by electrolytic deposition, thereby regenerating the acid which could be used for the treatment of malachite concentrate.

Fluidized Roasting

A serious study of roasting and leaching processes was undertaken by the Research Department of Union Miniere. Preliminary tests showed that the chalcocite flotation concentrate, which is very fine (70 percent minus-400-mesh or 37 microns), would agglomerate when temperatures reached 325° C. Pilot plant tests confirmed this fact and it was impossible to operate a 3-foot diameter multiple hearth furnace solely on sulphide concentrate due to agglomeration on the hearths and the shaft of the furnace.



The only way the material could be treated was tc mix return calcine with the feed resulting in a deficient heat balance.

Following this the Research Department experimented with fluidized roasting. Two experimental reactors, one of 4-inch diameter and the other 70 centimeters in diameter, were built and equipped with automatic electric heating systems. The electric heaters allowed roasting to be carried out at any given temperature.

The smaller furnace, with a capacity of 1 to 2 kilograms of dry concentrate per hour, had the following principal characteristics. The reactor itself is a 3-meter long pipe made of ordinary steel and with a 4-inch inside diameter. This pipe is freely hanging by its upper end inside a refractory shell; thus its expansion is possible at the lower part. A windbox is bolted at the bottom of the pipe, allowing the air to be blown along the whole surface of the base section.

Typical Analysis of Chalcocite Concentrates Obtained From Sulphide or Mixed Ores of Various Sources of Union Miniere

Origin And Description of Ore	*Kambove sulphide ore*	*Kolwezi sulphide ore*	*Kamoto mixed ore*	*Kamoto sulphide ore*	*Dikuluwe sulphide ore*	*Musonoi mixed ore*		*Musonoi sulphide ore*	
Concentrate Assay									
Cu total	50.69	51.22	50.74	42.04	47.98	45.11	44.88	47.51	56.83
Cu oxide	0.71	0.46	4.00	1.08	6.48	—	—	3.56	3.18
Co	0.96	0.32	1.12	1.63	0.05	1.01	2.83	0.58	0.74
Fe	2.78	1.53	0.95	1.65	2.18	0.94	1.33	1.20	2.10
S	16.62	13.18	12.97	12.58	9.93	11.94	14.10	11.64	14.47
SiO_2	11.00	17.30	31.05	24.79	19.80	20.30	17.97	20.46	15.60
Al_2O_3	0.63	3.46	2.80	1.84	2.34	4.02	3.03	2.87	1.70
CaO	2.19	2.14	0.57	3.08	4.10	3.71	3.68	2.36	1.30
MgO	6.16	3.47	0.59	3.09	4.22	3.86	3.50	3.96	1.74

A ¾-inch calcine overflow pipe goes clear through the windbox, extending into the reactor at the fluid bed level. The dry raw material is fed into the fluid bed by means of a small screw conveyor. The installation includes a cyclone and a dust bag, as well as a discharge hopper for the calcine.

The heating of the reactor is done by electric elements set between the reactor pipe and the insulating brick shell. Three sections of six heating elements each are provided and tensions from 65 to 105 volts can be reached. The lower heating element sections are operated by self-closing circuit-breakers and controlled by thermocouplers.

Control and regulation equipment included: a motor-reducer unit on the concentrate feeding system with adjustable speed and a capacity of 1 to 7-kilograms-per-hour; a rotameter to measure the air supply; thermocouplers probing the fluid bed and the gases; and pressure taps connected to U-tubes, serving as differential manometers.

The 70-centimeter diameter furnace was built according to the same principles as the 4-inch reactor; the shell was a cast chromium-molybdenum alloy made in the central workshop.

However, whereas the 4-inch reactor, had an important heat loss and needed uninterrupted electric heating, the 70-centimeter furnace only required heating at the start-up. When concentrate sufficiently rich in sulphur was treated a return of the calcine proved to be necessary to prevent the bed temperature from exceeding a fixed degree.

Roasting Conditions

The operation of the experimental furnaces were continually controlled by the indications of the manometers, pyrometers and eventually by a SO_2 analyzer. Furthermore the roasting products (calcines and dusts) were collected hourly, weighed and analyzed for copper, total sulphur and sulphate-sulphur. Leaching tests of the calcine were regularly carried out in order to control the copper and cobalt solubility.

The operating factors influencing roasting conditions were systematically studied. With regard to temperature of operation the following conclusions were drawn:

(a) The copper recovery by leaching is very good at 550° C. and reaches 97 to 98 percent for a roast at 675° C.

(b) It is necessary to up the temperature to at least 675° C. to obtain a good cobalt recovery, for example 90 to 95 percent.

(c) The solubility of iron goes down when the temperature increases; at 675° C. half of the iron remains in the leach tails.

(d) The recorded sulphur loss in the smokes reaches 20 percent of the initial S and this loss increases with the temperature.

To vary the feed rate and the bed depth means changing the average time spent in the reactor by the concentrate. It has been observed that to a certain extent an increase of this average time produces the same effect as an increase of temperature. The copper and cobalt recovery and the insolubility of iron increase with the time of the stay in the reactor; in the experimental reactors we consider as reasonable such capacities as 250 kilograms of concentrate per-square-meter-per-hour with a bed depth of 90-centimeters (3 feet).

Within the limits of good temperature and feeding conditions of the concentrate, we did vary the blown-in air volume from 101 to 170 percent of the theoretically calculated supply. An important air excess corresponds to an increased upward speed of the gases, an increased weight of the recovered dust in the cyclone and less sulphating of the dust. A favorable margin results from using an excess air volume of about 20 percent.

Favorable Agglomeration

Generally speaking, a favorable agglomerating phenomena of the particles has been observed in the reactor. Even when 95 percent of the crude concentrate is composed of particles below 74-microns (200-mesh Tyler), after roasting, 80 to 90 percent of the material is recovered in fractions exceeding 74 microns. Yet, no trouble has been observed during Fluosolid roasting due to the agglomerating phenomena as was experienced during hearth roasting.

For the actual test work a chalcocite concentrate rich in cobalt was chosen. The concentrate assayed 46.6 percent copper, 4.03 percent cobalt, 1.08 percent iron and 15.8 percent sulphur. The concentrate was fed at 230 kilograms per square meter. Bed depth was 90 centimeters; volume of excess air was 35 percent and the temperatures was 706° C. The analysis of the products of the reactor are shown in the accompanying table.

The leached residues of the calcines amount to 18.2 percent of the calcine weight and assay 4.51 percent copper, 0.79 percent cobalt and 2.52 percent iron. Recovery of copper in the leach solution was 97.9 percent and of cobalt was 96.2 percent. The available sulphuric acid was 170 kilograms per ton of roasted concentrate.

Only the copper sulphate-bound sulphur will produce free acid. Sulphur is partially lost in roaster gas, in leach residues as insoluble sulphates and some is lost as soluble sulphates such as calcium or magnesium sulphate. In the above test 83 percent of the sulphur in the concentrate feed is recovered in the calcine. Leaching losses and consumption absorbs 40 percent, so that 43 percent of the initial sulphur remains and provides enough for 208 kilograms of sulphuric acid per crude-concentrate ton.

Further knowledge of fluidized roasting will result from the 14-foot diameter reactor installed last year. From the roasting tests and from the large reserves of sulphide ore, every indication points to the fact that hydrometallurgy and electrolysis will become increasingly important in the future.

THE END

Kolwezi Mill

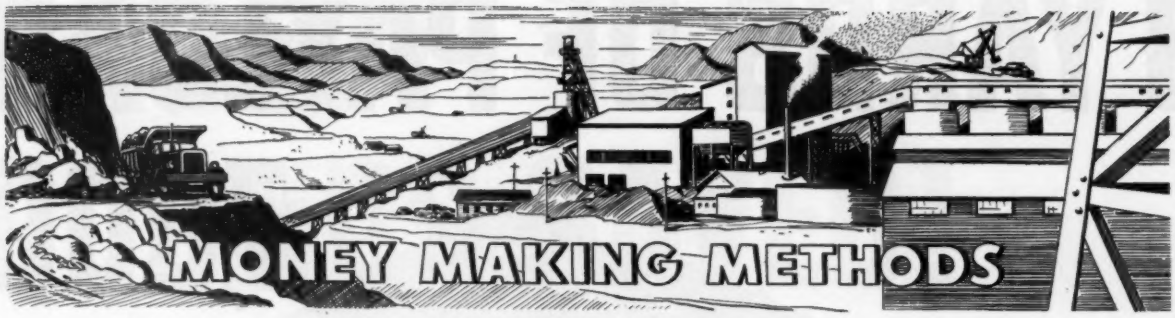
Continued from page 57 (WM49)

section of the Kolwezi Concentrator. The capacity of this special section is 75,000 tons of ore per month. The ore is ground in two rod-mills in open circuit, each of them feeding two duplex, screw, classifiers, which are in closed circuit with ball-mills.

Roughing is carried out in 16-cell machines. After flotation of the sulphides in 4 or 5 machines, the pulp is pumped to 5 or 6 machines of the same type. Cleaning is carried out in three, 4-cell machines for the sulphides and three, 8-cell machines for the oxides. The cleaner tails of the sulphide flotation and the middlings of the last sulphide roughers are reground, after cycloning, in a ball-tube mill with 1 to 1½-inch balls and returned to the sulphide roughing circuit.

The sulphide concentrate is smelted to produce blister copper. Later on a sulphate roast and leaching treatment will be possible in a new electrolytic plant being built at Kolwezi. The oxide concentrate is sintered and electrically smelted. The rough copper so obtained is converted into copper anodes and the cobalt is scorified in a supdiferous slag, which is re-treated in the electric cobalt furnaces.

THE END



Saunders Drop-Bottom Skip Dumps Faster With No Sticking of Wet Ore

Just out of the testing stage in one of the shafts of a Witwatersrand gold mine in the Union of South Africa is the Saunders patented drop-bottom skip. Proof of its advantages lies in the orders received and being received for operational installation in other gold mines. What has particularly pleased mine operators is the total discharge of the load from the body of the skip into the headframe bin. One of the difficulties previously experienced in handling wet, fine-ore is the cumulative packing in the conventional skip bottom. Despite the use of various devices to prevent or minimize this packing, cases are known where the discharge has been reduced to as little as 60 percent of the effective capacity of the skip.

The duration of the discharge in the case of the Saunders skip is approximately one-third of that for the Kimberley-type skip. Another marked advantage is the reduction by about one-half of the discharging or tipping travel, compared with that required for the conventional skip.

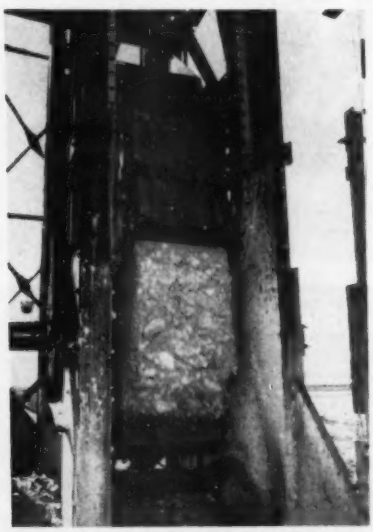
The Saunders skip can be mounted in any skip-hoisting system. The only modifications required are in the bridle and fitting of new tip-path or guide angles. These are referred to as the "tipping roller angles" in the diagram accompanying this article. In the tipping or discharging cycle, the body of the skip is swung laterally away from the vertical towards the tip chute on the headframe by the outward course of the tipping rollers in the relevant guides (illustrated in the accompanying diagram and photographs), the bottom load-retaining door swings down as the cam tracks under the door pass over the supporting wheel and axle assembly, and the load drops freely with the packed ore at the skip bottom passing out first.

The skip body can be of skeleton construction in steel or light alloy carrying body-plates that in themselves constitute liners, renewable when necessary. Alternately, it can be constructed more conventionally using angles, flats, and plates riveted together with renewable liners. The side plates on which the body is suspended carry bearing housings which, welded to the upper portion, are mounted on the skip pivot shaft. A stiffened cover plate, fitted to the side plates, prevents spillage during loading.

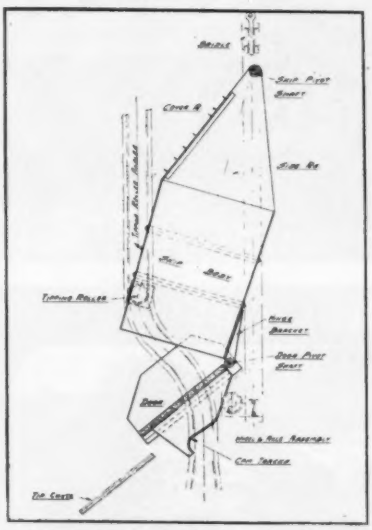
The skip door forms the bottom of the skip when closed, and a chute when open. The door consists of a floor plate; on the upper side sideplates are attached by angles; on the lower side are attached the two cam tracks, supported by the wheel and axle assembly mounted on the bridle. These tracks control the movement of the door during the tipping cycle, the point of discharge, and the slope of the door in the full tip position. The two bearing housings accommodating the door pivot shaft are welded to the sideplates, while the shaft itself is supported by two hinge brackets riveted to the rear of the skip body. In cases of severe loading conditions, the load-side, or upper side, of the door is cushioned with either rubber or timber on which is mounted or fitted a renewable steel-liner plate.

The bridle for the Saunders skip differs slightly from that of the conventional type in that it has a wheel and axle assembly to support the door cam tracks and thereby the door itself and the load. The skip pivot shaft is located off the vertical center line of the skip and bridle so that the body is held in position by gravity. Nevertheless, some users prefer to have a safety-catch fitted, similar to that of the conventional Kimberley skip, as a further precaution against premature tipping.

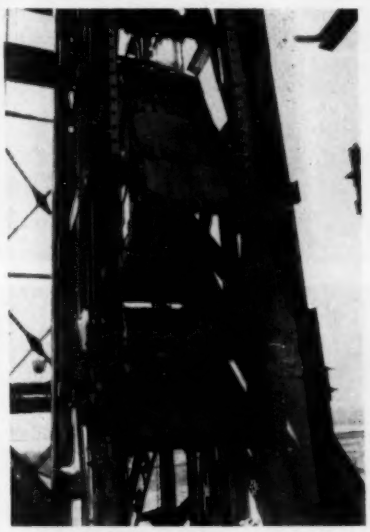
Continued on page 68



BOTTOM DROPS to let muck out fast.



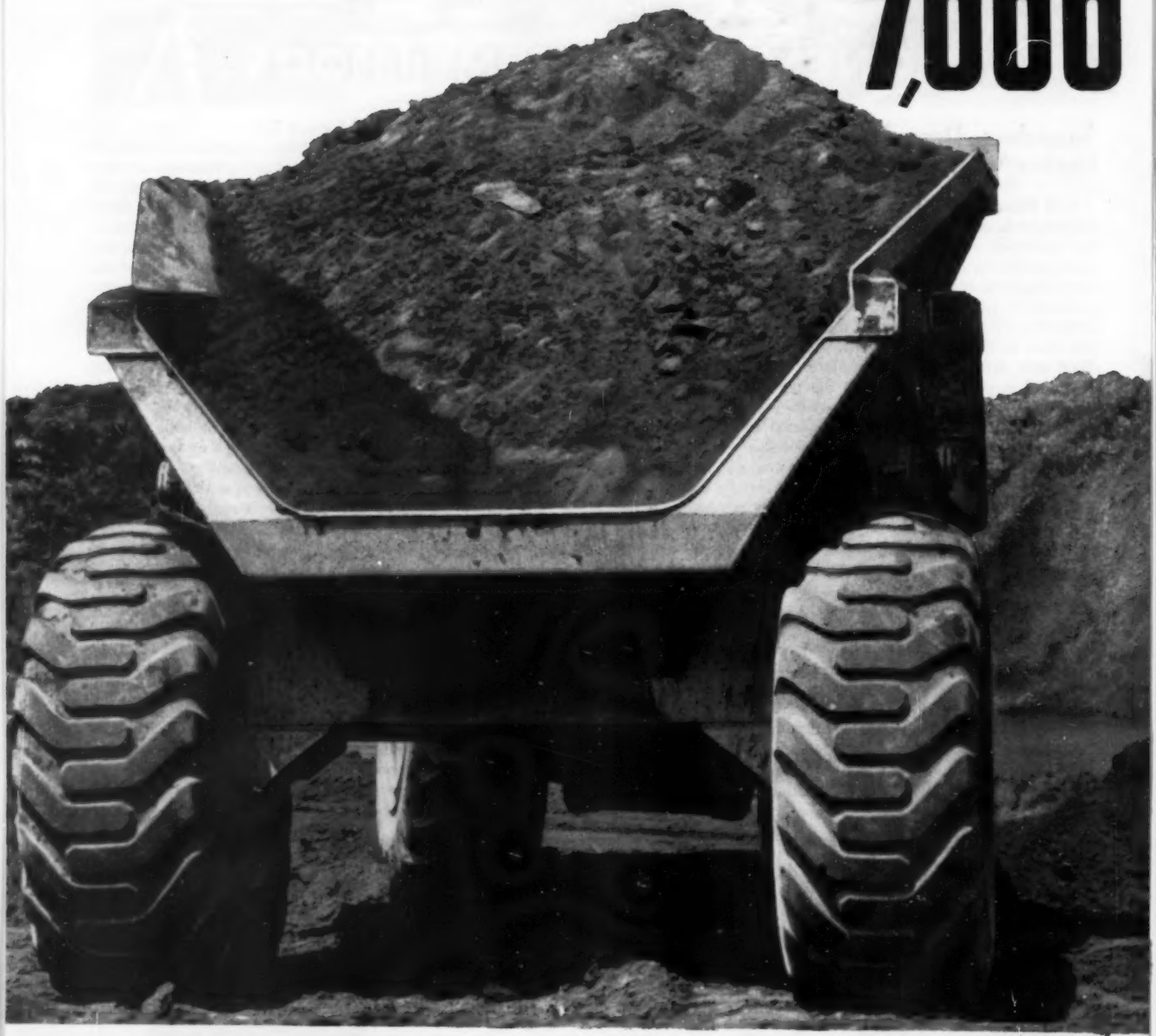
DUMPING device built in headframe.



CLEAN SKIP as all muck falls free.

8 YARDS OF PAYLOAD

7,000



WEIGHS 3½ TONS LESS

TRAVELS FASTER

CARRIES MORE PAYLOAD

ADDED! POUNDS SAVED!

High strength-to-weight ratio of USS "T-1" Steel solves difficult design problem

In the past, lightweight materials such as bauxite ore have presented a hauling problem *because* of their light weight. Standard hauling units, designed for heavier materials, had too much dead weight . . . couldn't haul enough volume of lightweight materials. Athey Products Corporation, Chicago, Illinois, has solved the problem with the help of USS "T-1" Steel.

Athey engineers designed a new rear-dump trailer specifically for high-volume lightweight materials. Starting point was a conventional 22.5-cu.-yd. trailer. The high yield strength of USS "T-1" Steel—90,000 psi minimum—enabled them to use much higher design stresses and, thus, reduce the thickness of steel required.

As a result, volumetric capacity of the 22½-cu.-yd. model was boosted to 30½ cu. yds. The new unit weighs just 13 tons—7,000 pounds less than it would if built with low-alloy steel. USS "T-1" Steel's toughness and resistance to impact abrasion give the trailer ruggedness and durability needed in off-road mountain service.

This lighter-weight trailer can travel much faster, when empty, than heavier standard units. As a result, it spends less non-productive time in making empty return trips to the mine. It not only carries more payload, but is hauling payload during more of its total operating time.

Where can you use USS "T-1" Steel?

Consider USS "T-1" Steel where you need an unusually high strength-to-weight ratio. Use it where you need unusual toughness and resistance to impact abrasion at low temperatures . . . where you need good high-temperature strength combined with toughness and resistance to abrasion. Remember, *all* of these properties are combined in USS "T-1" Steel *with good weldability*. Call, wire or write for more information. United States Steel, Pittsburgh 30, Pa.

SEE The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

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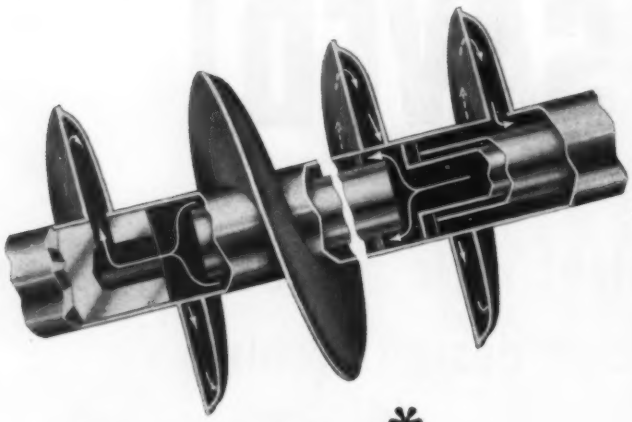
USS "T-1" CONSTRUCTIONAL ALLOY STEEL

UNITED STATES STEEL

New savings in heat-exchange processes...



THE holo-flite* PROCESSOR
(HOLLOW-FLITE)

A simpler, more compact way to cool, heat or dry—in continuous flow!

Do you have processes where slurries, solids, pulps or pastes must be cooled, heated or dried? Do you know you can now handle such processes—*in continuous flow*—in as little as 1/5th the space required by other types of heat exchangers—and with many other important advantages?

The revolutionary HOLO-FLITE Processor is the answer!

what IT IS!

Basically the HOLO-FLITE consists of two or more flights of hollow-bladed screw conveyors. The product to be processed moves in a trough around the conveyor screws. The heat-transfer fluid circulates through the hollow blades and shafts of the conveyor. The product is constantly rotated into, around, under and over the blades and shafts through which the heat-transfer fluid is circulating, assuring quick, uniform heat passage between the two mediums—*as the product is continuously moved along in a bulk-flow without interruptions!*

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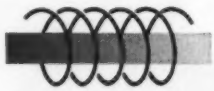
why IT'S BETTER!

The HOLO-FLITE principle provides many important advantages in modern processing operations...

ITS LARGE HEAT-TRANSFER SURFACE requires far less space—as little as 1/5th the space required by other heat-exchange equipment. Further, flights can be "stacked" as high as desired to save floor space, simplify installation!



ITS SLOW ROTATION IS SO GENTLE that granular and powdered solids are handled with no dusting—little or no particle abrasion. Result—no dust recovery problems... simple, inexpensive installation.

IT IS ADAPTABLE to a wide range of applications—handles solids, pulps, pastes and slurries with equal ease. Heat transfer agent can be refrigerant, water or other fluids to provide a wide range of temperatures. Cooled products can be packed directly from HOLO-FLITE discharge, saving time, space and additional handling.

IT CAN BE DESIGNED to handle virtually any capacity by varying the diameter and length of the flights, and the number of "tiers."

FREE 8 PAGE bulletin describes Holo-Flite features and applications. Send for your copy!

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Reverse-Jet Filters
HOLO-FLITE Processors
*Reg. T.M.

Western Precipitation Corporation

Designers and Manufacturers of Equipment for Collection of Suspended Material from Gases ... and Equipment for the Process Industries

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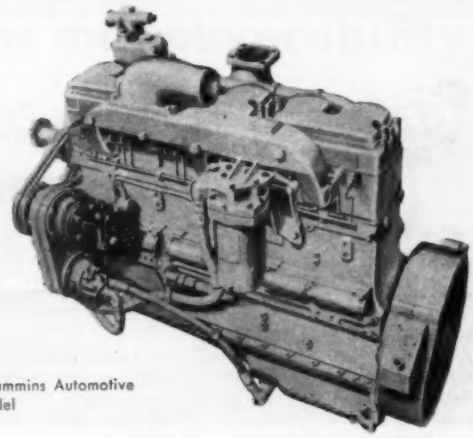
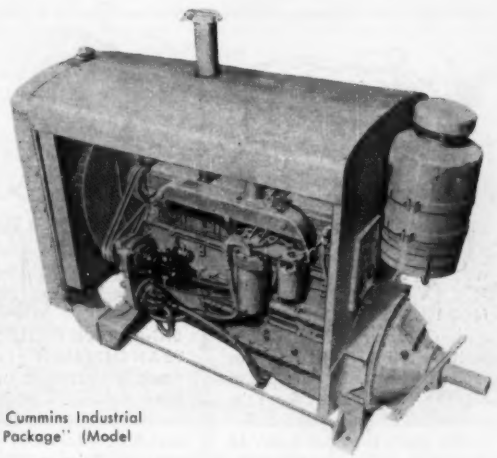
CUMMINS DIESELS

deliver more profit in any mining application!

175 h.p. Cummins Industrial "Power Package" (Model JT-6-IP)



210 h.p. Cummins Automotive Diesel (Model NHBI-600)



250 h.p. Cummins Industrial "Power Package" (Model NT-6-P)

- A complete line of Cummins Diesel models—60 to 600 h.p.—is available for:

Haulage trucks Tractors Shovels Cranes Draglines
Earth Motors Rock Crushers Dredges Air Compressors Industrial locomotives
and other types of power equipment used in mines.

- Six models of particular interest are the new Cummins ***Turbodiesel*** Engines. Here, exhaust gas energy, normally wasted, is utilized to boost the horsepower at the flywheel.
- All models feature the exclusive PT fuel system. This PT fuel system has fewer parts . . . costs less to maintain than any other fuel system—gasoline or diesel. Operation of the PT system is simple and foolproof . . . servicing is easy.
- Features that have made Cummins Diesels world-famous: 4-cycle operation for long life . . . finest dirtproofing protection . . . lightweight, high-speed design.
- Cummins worldwide network of distributors keeps service and parts readily available wherever you are . . . whenever you need it. Nearly 300 Service and Sales points are located throughout the world.

The Cummins Engine Company salutes Union Miniere du Haut-Katanga on its 50th anniversary. Over 200 Cummins Diesels are on the job at this famous mine. UMHK has standardized on Cummins for more profit!

CUMMINS MORE PROFIT

gives you the ***big plus***

Cummins Engine Company, Inc., Columbus, Indiana

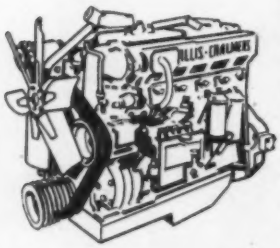
Export—Cummins Diesel Export Corporation—Columbus, Indiana, U.S.A.—Cable: CUMDIEX

Overseas Factory—Cummins Engine Company Limited—Shotts, Lanarkshire, Scotland—Cable: CUMSCOT

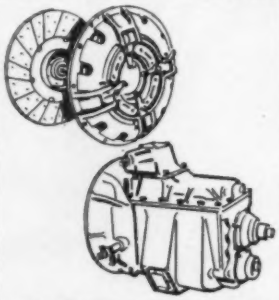
Look at the EXTRA WORK OUTPUT

the Allis-Chalmers TS-360 Motor Scraper gives you

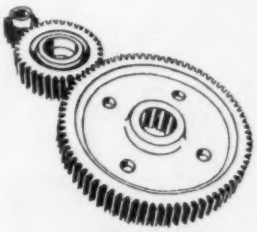
Here are some of the design features that put the TS-360 way out in front in steady performance, dependability and length of service life.



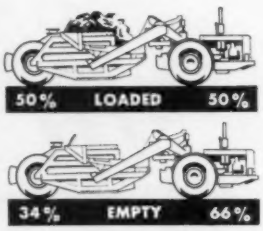
MORE USABLE HORSEPOWER. Allis-Chalmers diesel engine delivers 280 hp — 18.66 hp for each struck yard. This power gets the TS-360 away from the pusher fast . . . gives you speedier cycles, more trips per hour. In this engine, follow-through combustion holds effective working pressures to take advantage of better crankshaft leverage.



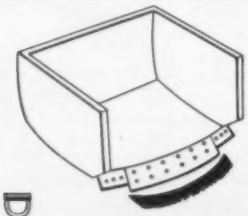
BIG-CAPACITY CLUTCH AND TRANSMISSION give fast, smooth operation under all job conditions. Clutch has air-actuated booster to reduce clutching effort and increase shifting efficiency. The heavy-duty transmission gives unmatched torque output in each gear range.



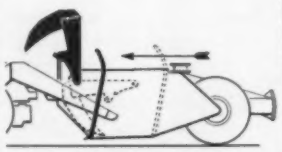
EXTRA-HEAVY FINAL DRIVES feature rugged differential assembly, carrier-housed drive shafts, final drive gears supported by large roller bearings and heat-treated drive axles. This long-life power train transmits maximum engine output for extra work volume, extra profit.



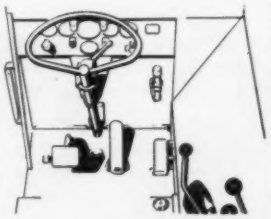
EXTRA TRACTION. The TS-360 motor scraper provides greater tractive effort, loading or traveling. Two-thirds of the empty weight is carried on drive wheels. Loaded weight is distributed equally between tractor and scraper wheels for better balance, increased flotation, safer hauling.



EASY-LOADING BOWL. Wide, low bowl design with curved bottom and offset cutting edge assures full capacity loads in less time. Curved bowl bottom "boils" dirt in, filling corners, heaping load with less spillage.



CONTROLLED DUMPING ACTION. Forward movement of ejector forces out load. High apron lift prevents material from jamming. This combination provides a continuous flow of material for a smooth, even spread.



POSITIVE STEERING. Two-stage selective power steering makes the operator's job easy . . . provides safe, feather-touch response and full maneuverability whether traveling at high speeds or in cut or fill.

OPERATOR CONVENIENCES add to production, too. Easy-to-reach controls, full visibility, four-wheel air brakes, roomy platform, comfortable air-foam seat are some of the features that help operator get maximum output from the TS-360.

More and more TS-360's are coming into your area every day. Ask your Allis-Chalmers construction machinery dealer where you can see them in action. Remember, too — your Allis-Chalmers dealer stocks True Original Parts and offers factory-approved service methods and factory-trained servicemen for your convenience.

ALLIS-CHALMERS CONSTRUCTION MACHINERY DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

New capacity!

The completely new Forward Control 'Jeep' FC-150—the first time a 4-wheel-drive Truck has so effectively combined maximum cargo capacity with exceptional maneuverability! New Forward Control design puts a 74" pickup box on an 81" wheelbase. And the FC-150 retains famous 'Jeep' ruggedness and versatility.

New maneuverability!

It's the world's shortest turning 4-wheel-drive Truck! For safer off-road maneuverability, it gives you up to 200% greater forward visibility. Powered by the engine that made 'Jeep' vehicles famous, the new FC-150 provides the extra traction of 4-wheel drive for off-road travel, shifts into 2-wheel drive for highway travel.

New style!

The new look and feel of tomorrow! The FC-150's Safety-View Cab combines beauty with utility. Its new wrap-around windshield is the largest in the 5,000 GVW class. There's plenty of extra leg and head room. Here is new styling, comfort, convenience and safety all in today's most advanced 4-wheel-drive Truck.

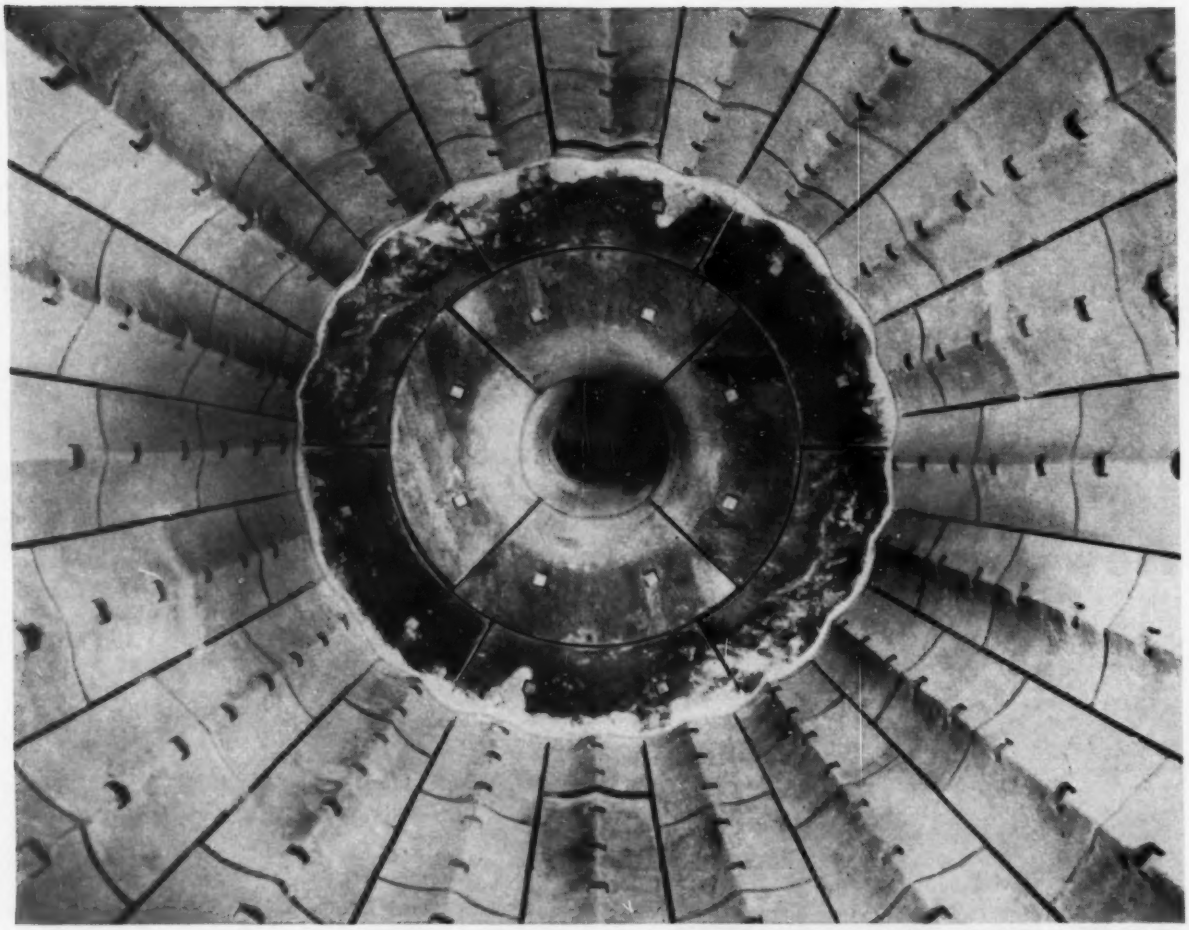
New 'Jeep' 4-Wheel-Drive Forward Control FC-150

Willys... world's largest makers of 4-Wheel-Drive vehicles

...other members of the famous 'Jeep' family:

Universal 'Jeep' | 'Jeep' Truck | 'Jeep' Utility Wagon

See 'Jeep' vehicles at your WILLYS dealer



Amsco Alloy Ball and Rod Mill Liners

For longer mill life specify AMSCO®
BALL AND ROD MILL LINERS

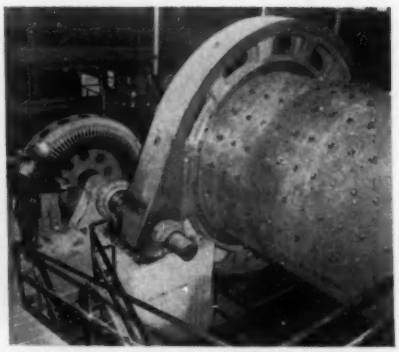
Processing iron ore, copper ore and cement mill clinkers gives a real workout to ball or rod mill parts

For top grinding efficiency, liners of numerous designs found in many leading makes of ball and rod mills are cast from special Amsco Alloy steels. These wear-tough steels are specially engineered to give the highest resistance to wear from abrasion and impact.

Amsco engineers and metallurgists have long co-operated with the manufacturers of ball and rod mill equipment to provide the right wear-resistant liner alloys and the advanced design features that will insure top mill performance.

If you have a problem with fast-wearing and costly mill liners, Amsco can recommend the right solution for you... in either special alloys or manganese steel.

Why not contact your ball or rod mill manufacturer's representative today and inquire about longer wearing Amsco Ball or Rod Mill Liners?



Standard Allis-Chalmers diaphragm ball mill equipped with Amsco Alloy Liners.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DEL., OAKLAND, CAL., ST. LOUIS; JOLIETTE, QUEBEC

Out where performance alone is not enough!

Near Butte, Montana, a CAT* DW20 Tractor works on a haul road at an open-pit copper mining operation. The road, half a mile long and 60 feet wide, had to go in fast. So a pair of DW20s with Scrapers dumped some 1600 cu. yd. of dirt per 8-hour day, and did it day in, day out till the job was done.

And that's the point: *day in, day out* till the job is done. For, on the hard jobs, performance alone, while mighty important, is not enough.

Sure, DW20 units give superior performance. Big capacity. Load easily. Big rimpulls that overcome grade and rolling resistance on rough roads. Ejection that gets rid of any kind of material quick. And, of course, high speed.

But the DW20 does more than a good job. It *stays* on that job. It shrugs off the down time that hurts you in your cost-per-yard figure. Your Caterpillar Dealer is ready with facts and figures to prove that the built-in durability of the DW20 means dollars and cents to you. He's ready, too, with expert service—and with replacement parts you *know* you can trust.

P.S.: Your Caterpillar Dealer will demonstrate the DW20 on your job, at your say-so—with any of its famous running mates: the new No. 456 Scraper with LOWBOWL design; the Athey PH20 Wagon specifically designed as an economical coal hauler (56 cu. yd. heaped load); and the Athey PD20 side dump Wagon with a heaped capacity of 25 cu. yd.

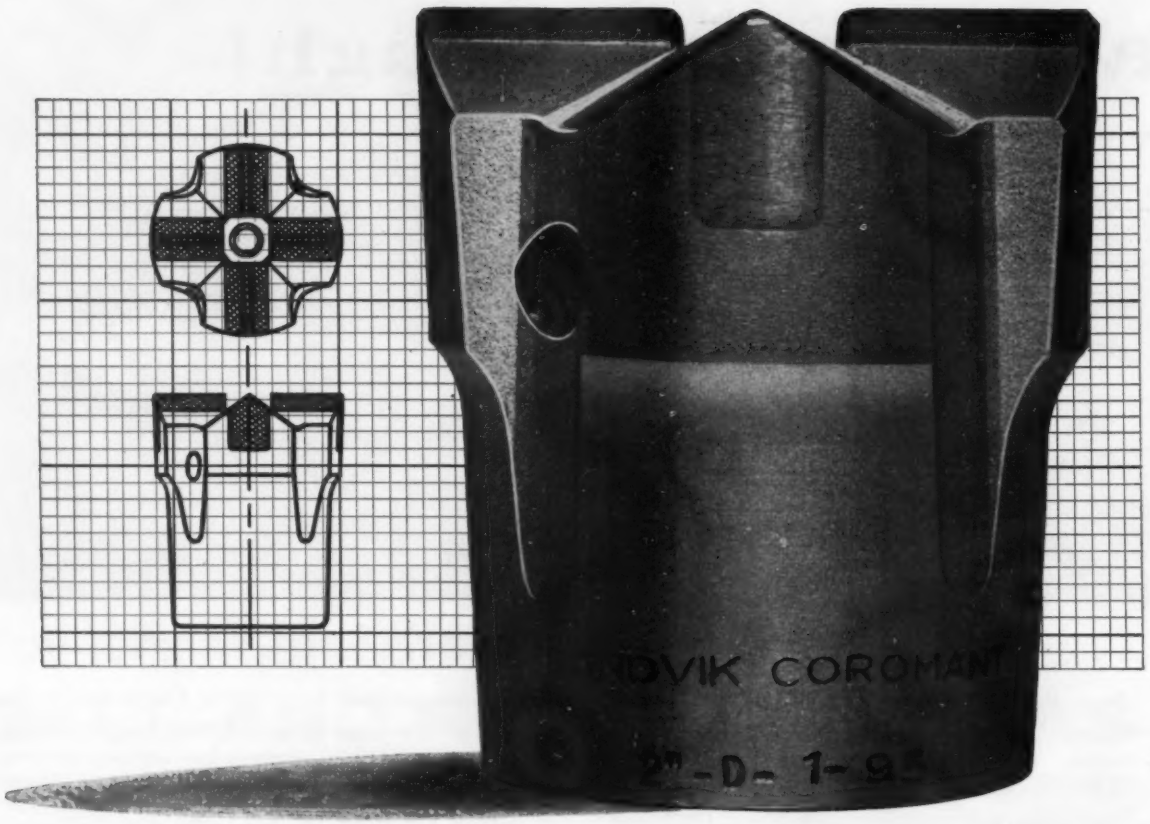
Caterpillar Tractor Co., San Francisco, Calif.; Peoria, Ill., U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

WANTED—
THE HARD WORK

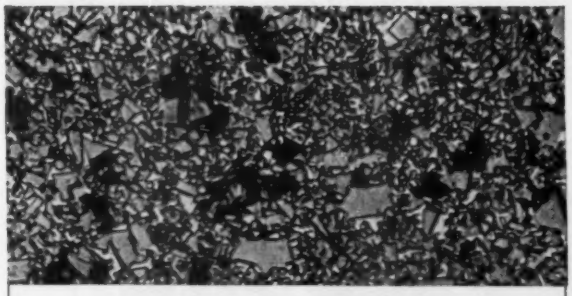
THIS ROCK BIT IS PRECISION-MADE FOR A HIGHER PERFORMANCE



Nothing tougher and more wear-resistant than the insert of a Sandvik Coromant 776 bit

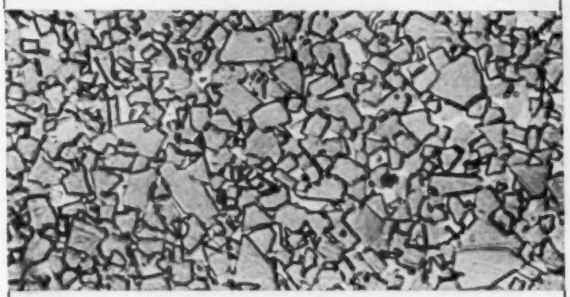
Rock bits that go on *and on* must have highest-grade tungsten-carbide inserts. Nothing but tungsten carbide in its purest state is good enough, will last as long. That's why the carbide that goes into a Sandvik Coromant 776 bit is meticulously controlled.

Sandvik, the world's largest manufacturers of brazed-in tungsten-carbide inserts for rock drilling, control every phase of production. Coromant carbide is scrutinized for impurities from the very first stages of processing the tungsten ore, right through to the final inserts. Add to that Sandvik's special process of securing the insert to the body, employing an exceptionally strong bonding metal, and you know why a Coromant 776 bit lasts longer. In 1955, one billion feet were drilled with these inserts, all fitted to Sandvik Coromant bits or integral steels. *Nothing is more conclusive of the quality of Coromant bits than this figure.*



LOW QUALITY TUNGSTEN CARBIDE

These are unretouched, 1200-times enlarged microphotos. Above, carbide full of impurities. Those black marks are contaminations which are present when production and quality control are deficient. Contamination of this kind weakens the carbide and reduces its working life.



SANDVIK COROMANT TUNGSTEN CARBIDE

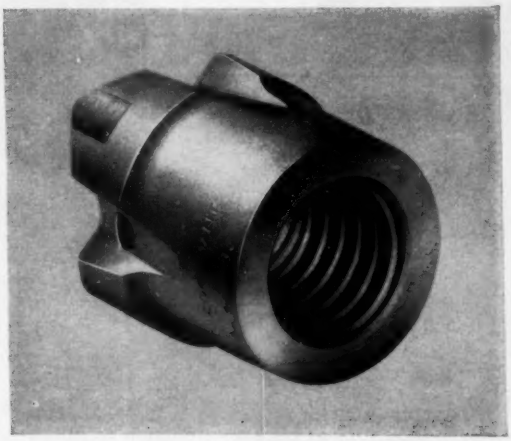
This is Coromant carbide. Notice the uniformity of size and the even distribution of grain. Coromant inserts are free of dangerous porosity and impurities—the reason they go further, have greater strength.

Nothing stands the strain like the Swedish body of a Sandvik Coromant bit

When you put the strongest possible tungsten carbide into a rock bit, the body has to be the strongest available to take the extra strain. That's why Coromant bodies are made of high-quality Swedish alloy steel. But that's not all. Inserts and clearance are cylindrically-ground and the insert ends precision-tooled to exactly the same height. This means *smoother* drilling and *smoother* holes, because the load is equally distributed on all four inserts. *Precision engineering such as this give Coromant bits a longer life!*

Nothing fits like the precision-milled threads of a Sandvik Coromant bit

In order to get a smooth profile of the highest accuracy, Coromant threads are precision-milled in a special thread-milling machine and not made with a tap. Precision-milling too protects the skirt from common fatigue failures.



SANDVIK COROMANT 776 BITS

and Sandvik Coromant integral steels are available in standard sizes through Atlas Copco, who, in their own field, are the world's largest manufacturers of rock drills. Contact any of these offices *today* for further information and a demonstration.

U.S., Atlas Copco Pacific, Inc., 930 Brittan Avenue, San Carlos, California. Atlas Copco Eastern Inc., P.O. Box 2568, Paterson 25, N.J.
CANADA, Atlas Copco Canada Ltd., Montreal Airport, P.Q.
MEXICO, Atlas Copco Mexicana S.A., Apartado Postal 56, Torreon, Coahuila.

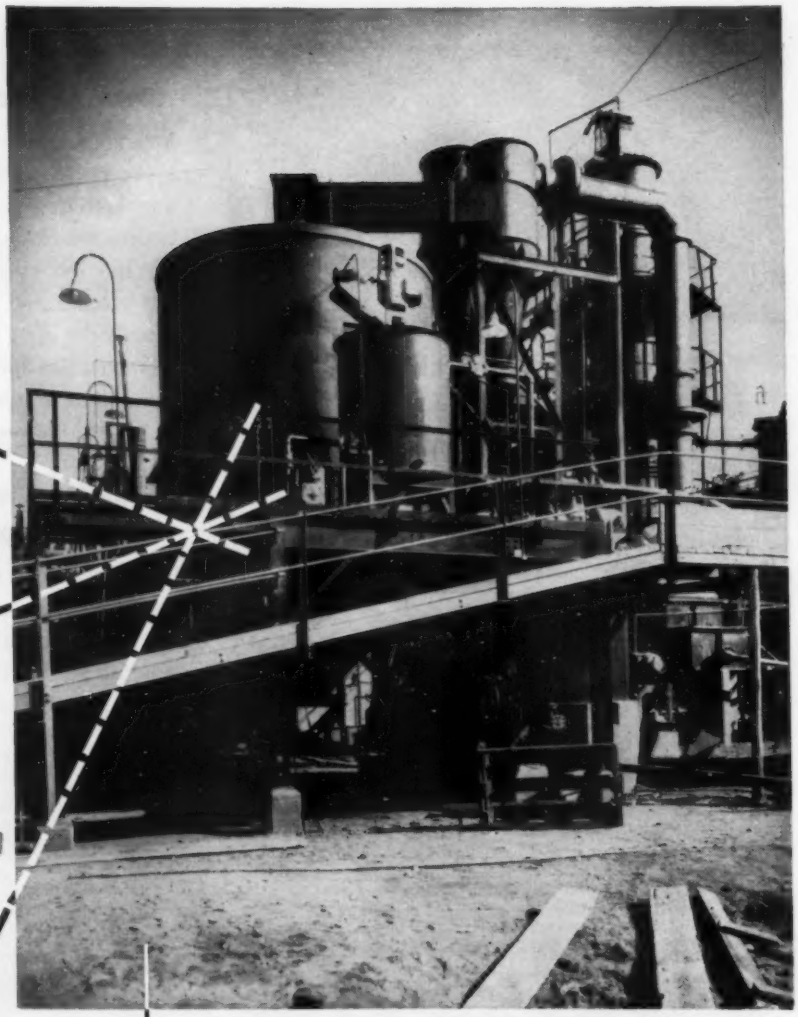
Atlas Copco

Manufacturers of Stationary and Portable Compressors, Rock-Drilling Equipment, Loaders, Pneumatic Tools and Paint-Spraying Equipment

IN SOUTH AFRICA

AROUND THE CLOCK

A TANK CAR AN HOUR OF H_2SO_4



This FluoSolids System at West Rand Consolidated Gold Mines, Ltd. on South Africa's fabulous Witwatersrand was started up early in 1952. The first of several to go into operation on the Rand, it was also the first in the world to combine FluoSolids roasting of pyrite with a contact acid plant.

Over 1650 tons of H_2SO_4 — enough to fill twenty-four tank cars — are being produced every day for uranium leaching at seven South African mills.

An important part of each of these installations is a Dorrco FluoSolids System. Cumulatively the Systems include nineteen Reactors, of which sixteen were on original order and three on repeat orders, plus additional Dorr-Oliver and auxiliary equipment to produce a high strength SO_2 gas for acid manufacture by conventional contact acid plants.

Total feed to the Systems is 1450 tons per day of pyritic gold mill tailings — averaging 35 to 45% total sulfur, gas production is 75,000 to 82,000 SCFM. Gas strength averages 12 to 13% SO_2 . . . sulfur recovery approximately 90%.

The efficiency and economics of the Dorrco FluoSolids System is in evidence in these facts. Additional representative proof that the FluoSolids process can produce an SO_2 gas at lower investment and operating costs than other roasters.

If there's a step in your flowsheet where intimate contact between solids and gases is essential, fluidization should be investigated. Just drop a line to Dorr-Oliver Incorporated, Stamford, Connecticut.

FluoSolids is a Trade Mark of Dorr-Oliver Incorporated, Reg. U. S. Pat. Off.

DORR-OLIVER
INCORPORATED
WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT
STAMFORD • CONNECTICUT • U.S.A.

NORDBERG MINING MACHINERY

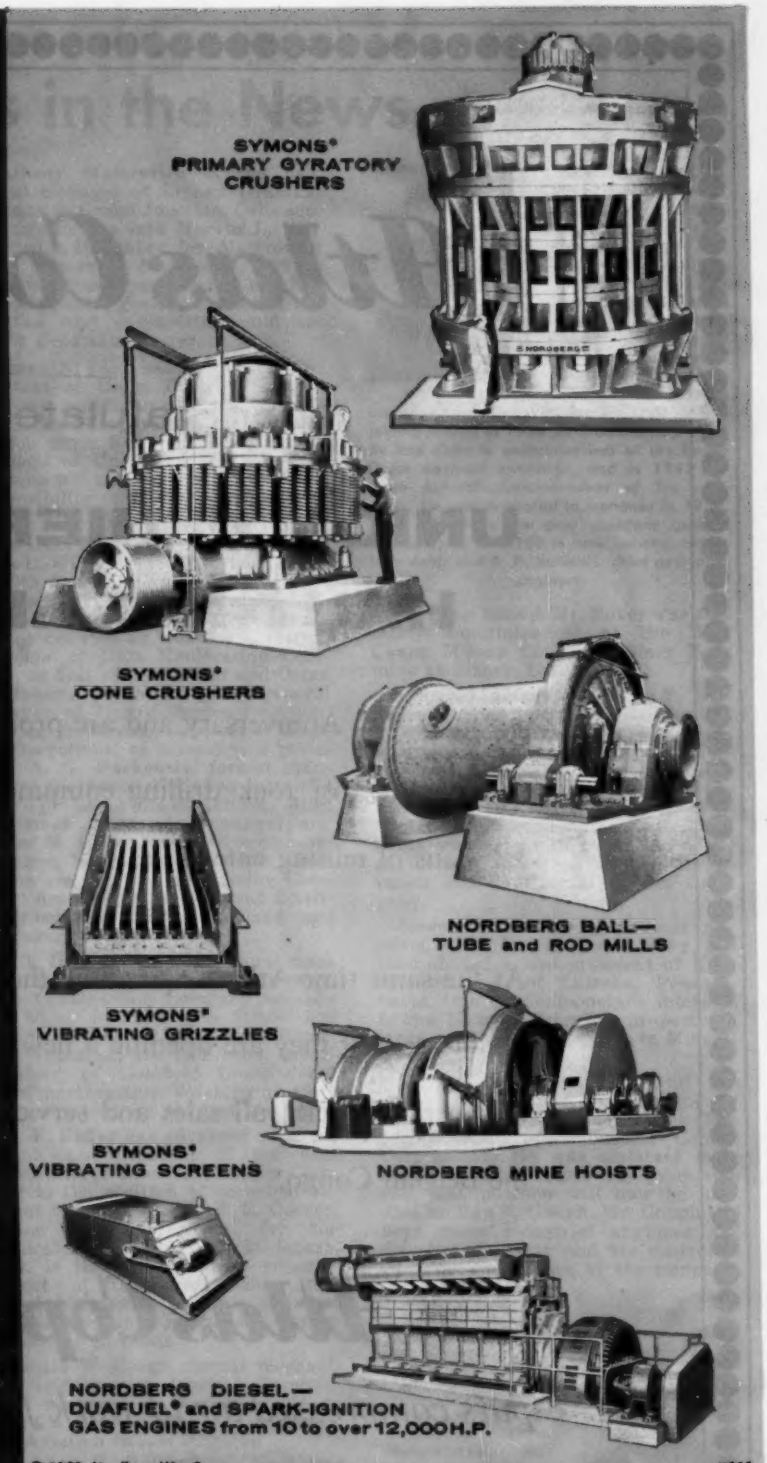
..."Standard of The World"

for PROFITABLE REDUCTION of ORES and MINERALS

Wherever ores and minerals are processed in quantity, Nordberg Mining Machinery is now in use or being installed. Efficiency-minded operators depend on Nordberg Machinery to assure maximum and continuous production at low operating and maintenance cost. Designed and built for the Mining Industry, this outstanding machinery has become a *"Standard of the World."*

Nordberg Machinery includes *Symons** Primary Gyratory Crushers for primary breaking; *Symons* Standard and Short Head Crushers for fine reduction crushing; *Symons* Vibrating Bar Grizzlies and Screens for scalping and sizing; Grinding Mills for wet or dry grinding; Mine Hoists; and a broad line of Diesel and Gas engines in sizes from 10 to over 12,000 H.P.

Write for literature on the machinery you need.


SYMONS* PRIMARY GYRATORY CRUSHERS
SYMONS* CONE CRUSHERS
NORDBERG BALL—TUBE and ROD MILLS
SYMONS* VIBRATING GRIZZLIES
NORDBERG MINE HOISTS
SYMONS* VIBRATING SCREENS
NORDBERG DIESEL—DUAFUEL* and SPARK-IGNITION GAS ENGINES from 10 to over 12,000 H.P.

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NORDBERG MFG. CO.,
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NORDBERG

MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

NEW YORK • SAN FRANCISCO • DULUTH • WASHINGTON
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***SYMONS**... *A Registered Nordberg Trademark known throughout the world*

Atlas Copco

congratulate

UNION MINIERE DU HAUT-KATANGA

on their 50th Anniversary and are proud to be one of the suppliers of rock drilling equipment to this most fabulous of mining enterprises.

* * *

At the same time Atlas Copco take the opportunity to announce that they are opening a new branch office in Elizabethville with full sales and servicing facilities for the Belgian Congo.

Atlas Copco

puts compressed air to work for the world

Branches in U.S.A. at Paterson, N.J., and San Carlos, Calif. Also in Canada at Montreal.

United States

Personalities in the News

HAROLD E. LEE has been promoted from manager of metallurgy to the newly created position of vice president in charge of research and development for The Bunker Hill Company at Kellogg, Idaho. Mr. Lee joined Bunker Hill in 1931, and as manager of metallurgy was responsible for the company's reduction plants. B. F. MAHONEY is the new assistant manager of employee and public relations, and was previously manager and Idaho agent for the Bradley Mining company's Yellow Pine mine and smelter at Stibnite, Idaho.

The American Institute of Mining, Metallurgical, and Petroleum Engineers will present 12 awards for distinguished professional achievement and contributions at the annual AIME meeting in New Orleans, February 24 to 28. **Andrew Fletcher,** president of St. Joseph Lead Company, will receive the Charles F. Rand Medal "for distinguished administration in non-ferrous mining and metallurgical enterprises, for his inspiring leadership in the mineral industry . . ." The James Douglas Medal will go to **Russel B. Caples,** president of Anaconda Aluminum Company, "for distinguished achievements in extractive metallurgy, particularly in the electrowinning of zinc, and for outstanding success in stimulating the professional careers of many metallurgists." **Antoine Mar Gaudin,** professor of mineral dressing at the Massachusetts Institute of Technology, will receive the Robert H. Richards Award "for his contributions as a scientist, educator and author; specifically for his leadership and direction in the development of leaching and recovery techniques for low-grade uranium ores." The D. C. Jackling Award will be given to **Joseph L. Gillson,** geologist for E. I. du Pont de Nemours & Company.

Ralph E. Magnuson, Jr. has been promoted to chief mining engineer for the Cleveland-Cliffs Iron Company on the Michigan Ranges. He will add the duties of this position to those he has as administrative assistant. **Daniel Isaacson** has been named district mining engineer to assist Mr. Magnuson.

JOHN R. POST has joined Out West Uranium & Oil Company, Denver, as president and general manager, succeeding RICHARD K. BAKER who has resigned to devote his time to other interests. Mr. Post was formerly St. Louis district manager for Commercial Solvents Corporation, with whom he was associated for the past 10 years. Out West recently contracted with Vitro Corporation of America to drill and mine promising Out West claims in the Gas Hills area of Wyoming.

Anthony Mastrovich is the new general manager of Climax Uranium Company in Grand Junction, Colorado. He succeeds the late **Marvin L. Kay** who died in December. Mr. Mastrovich joined Climax in September 1952 as assistant mine superintendent and has since been chief geologist, chief of exploration and engineering, and assistant general manager.

Lyman A. Bliss has been appointed president of Union Carbide Nuclear Company, a division of Union Carbide and Carbon Corporation. He assumes the job from **Kenneth Rush,** a vice president of Union Carbide and Carbon, who will continue to have over-all responsibility for the corporation's nuclear and international activities.

The Utah Mining Association elected **Clark L. Wilson** to be 1957 president at its 39th Annual Meeting in Salt Lake City recently. Mr. Wilson, vice president of New Park Mining Company, will be assisted by **Charles A. Steen,** president of Utex Exploration Company, as first vice president and **Oscar A. Glaeser,** vice president and general manager of United States Smelting, Refining & Mining Company's Western Operations, as second vice president. **A. G. Mackenzie,** former manager of the Association, was sustained as vice president and consultant; **Miles P. Romney** as secretary-manager; and **Walter M. Horne,** assistant secretary-manager. New members of the Association are the Sunshine Mining Company; American Zinc, Lead and Smelting Company; and McFarland and Hullinger.

A. V. Quine is the new general manager of Lucky Mc Uranium Company, Utah Construction Company subsidiary, which is building a $10,000,000 uranium processing plant near Riverton, Wyoming. He had been superintendent of Goldfield Consolidated Mines' northeastern Washington zinc-lead operations for the last six years.

W. F. Keffer has advanced from assistant superintendent of the acid department of Tennessee Copper Company to the position of technical assistant to the manager. **R. E. Carver,** former general foreman for the chemical division of the acid department, is the new assistant superintendent of the department. **John Branch** has moved up from assistant general foreman to replace Mr. Carver as general foreman.

Donald W. Cargo, former mechanical engineer with Jones & Laughlin Steel Corporation, has resigned to accept a position with North American Aviation in Los Angeles.

Norman G. Helland has been promoted to assistant general superintendent of Oliver Iron Mining Division's Hibbing-Chisholm district. He has been with Oliver since 1942 when he started as a mining engineer. Prior to his new appointment he was superintendent of the Hull Rust mine.

Robert E. Baker, research metallurgist for the Wah Chang Mining Company, has been transferred to the tungsten reconditioning plant at Glen Cove, Long Island. Mr. Baker was formerly superintendent at the Wah Chang Mining Company, Black Rock mine at Bishop, California.

BENJAMIN R. COIL (left) has been named to replace ROBERT W. HUGHES as general manager of Miami Copper Company in Miami, Arizona. After 32 years with the company, Mr. Hughes resigned because of ill health. Mr. Coil was employed by Braden Copper Company in Rancagua, Chile before joining Miami in 1936 as a mucker. By 1943 he had risen to superintendent of the Castle Dome open-pit operation, and in 1945 became general superintendent of the company. He was promoted to manager in 1955. J. H. GRAY is the new assistant general manager; C. C. WEBB is now general superintendent; and R. P. HUGHES, chief designing engineer.

Joseph T. Layne and **Ernie F. Williams** have been named to positions as industrial engineers at the Ray Mines Division of the Kennecott Copper Corporation. Mr. Layne was previously a consultant electrical engineer for the Layne and Layne Electrical Contractors, of Richmond, Virginia. Mr. Williams was employed as an industrial engineer for General Electric Corporation and Continental Rubber Company.

Joseph L. Kane, retired Rear Admiral of the United States Navy, has been elected a vice president of Kennametal, Inc. of Latrobe, Pennsylvania. One of Kennametal's interests is the Nevada Scheelite property, a large producer of tungsten in Mineral County, Nevada.

Ernest C. Simkins will fill the newly created post of director of labor and personnel for the Utah Copper Division of Kennecott Copper Corporation. He was assistant mine superintendent before his promotion and that position will now be handled by **Ray F. Gough.** Mr. Gough had been mine industrial engineer and director of safety and fire control in the Salt Lake office of the company.

MORRIS V. MIELKE is the new assistant general superintendent at Oliver Iron Mining Division's Eastern district operations, with headquarters at Virginia, Minnesota. Mr. Mielke joined Oliver, a division of U. S. Steel Corporation, in 1948 as an assistant concentration engineer in the Duluth research laboratory. In 1951 he was transferred to Oliver's Extaca agglomeration taconite plant at Virginia, and became superintendent in June 1952. He has been active in the experimental program to find practical means of concentrating and utilizing the company's taconite reserves.

BEAR IN THE BORROW PIT

THIS D9 LOADS SCRAPERS WITH 25 HEAPED YARDS IN 45 SECONDS

Phil Dudenhoefer, grade superintendent, knows from production charts that the D9 pusher loads more yards faster, at lower cost.

Working near Eau Claire, Wis., on a highway relocation job, L. G. Arnold, Inc., cut cycle times and boosted yardage with a Caterpillar D9 Tractor push-loading a CAT* DW21 and No. 470 Lowbowl Scraper.

On a round-trip haul of 3 miles they averaged 100 cu. yd. per hour—4 heaped loads of 25 cu. yd. each. Loading time on overburden, with the mighty D9 pushing, was an average of only 45 seconds.

Phil Dudenhoefer, grade superintendent for L. G. Arnold, Inc., says, "I've got both feet right in the dirt, where I record output and performance of every machine. With the D9 as pusher, the DW21-No. 470 unit is outproducing by far any other equipment on the job."

That experience has been shared by hundreds of owners, as more and more D9 Tractors have gone to work in borrow pits or on stripping operations. For fast loading you simply can't beat the D9, with its 320 HP at the flywheel and maximum drawbar pull of 98,000 pounds. Power-boosted controls and excellent visibility make this giant one of the easiest of all tractors to operate. It's available either with torque converter or direct drive with oil clutch. Maintenance is easy, too. And it's ruggedly built to lick the world's toughest jobs.

Your Caterpillar Dealer can show you actual performance records of higher production at lower cost per yard. He'll give you a demonstration right on the job. And he stands behind the long life of every machine with reliable service and parts you can trust.

Caterpillar Tractor Co., San Francisco, Calif.; Peoria, Ill., U. S. A.

CATERPILLAR*

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HEAVY-DUTY EARTHMOVERS FOR THE HARD WORK

Newsmakers in International Mining

W. G. JEWITT has been named vice president in charge of mines for the Consolidated Mining and Smelting Company of Canada Limited. He joined the company in 1927, was appointed manager of mines in 1948, and assistant general manager in 1952. D. D. MORRIS, who joined the company in 1928, has been chosen for the post of assistant general manager. B. E. HURDLE is the new assistant manager of mines and will be responsible for all of Cominco's producing mines; J. R. GIEGERICH succeeds him as general superintendent of operations at Kimberley. R. J. ARMSTRONG has been named assistant to the vice president in charge of mines.

Russell Bryant, Jr., former mine superintendent of the Cerro Bolivar iron ore mine of the Orinoco Mining Company in Venezuela, has been engaged by Van Sickle Associates Inc. to direct the development of the El Trueno and Real Corona iron ore deposits in Venezuela. Initial shipments are planned for late 1957. Mr. Bryan is president of the mining development and consulting firm of Russell Bryan Associates, Inc. with offices in Caracas, Venezuela, and San Francisco, California. Since leaving Orinoco he has been engaged in iron and cement developments in Venezuela, Mexico, the Dominican Republican, and Guatemala.

Robert P. Koenig and **A. Russell Merz** have been elected presidents, respectively, of Cerro de Pasco Corporation (Delaware) and Cerro de Pasco Sales Corporation. Both companies are new wholly owned subsidiaries of Cerro de Pasco Corporation (New York) of which Mr. Koenig is, and will continue to be, president and Mr. Merz, vice president. **John W. Hanley** has been elected a vice president of Cerro de Pasco Sales Corporation. Mr. Hanley has been employed continuously by the company since his graduation from Michigan College of Mining and Technology in 1933; most recently he was chief metallurgical engineer. Under a corporate realignment plan, the company's Peruvian operations and assets are now directed by Cerro de Pasco (Delaware), and sales handled by the new Sales Corporation subsidiary.

Dr. James M. Harrison has been named to succeed Dr. George Hanson as director of the Geological Survey of Canada. Dr. Harrison joined the Survey in 1943 and has recently been acting chief of the Survey's Precambrian Division.

R. K. Sinha is now stationed in New Delhi, India, as assistant mineral economist of the Indian Bureau of Mines.

Col. Andres Soriano, president of Atlas Consolidated Mining and Development Corporation and other Philippine mining and manufacturing firms, was awarded the Legion of Honor of the Philippine Chemical Society for "his distinguished achievements in the field of industrial leadership."

Dr. Gunther Zeschke, German geologist who has prospected for uranium throughout Europe and Asia Minor, recently joined the newly created geology and mineralogy department of the University of the Punjab, Lahore, India. Dr. Zeschke has been sent to India under the program of technical assistance of the United Nations Educational, Scientific and Cultural Organization.

Belcher Mining Corporation of Ontario, Canada is now under the control of Little Long Lac Gold Mines, and a new board of directors has been chosen which includes **Douglas Banks, Robert C. Stanley, Jr., G. Adams, John C. L. Allen,** and **Mr. Boeckh.**

Alfred Velguth, manager of Samar Mining Company, Philippine Islands, recently completed a tour of Australian mining and metallurgical areas.

Dr. Sture Linnér of Sweden has been appointed assistant manager of the English subsidiary of the Swedish Grangesberg-Oxelosund and Luossavaara-Kiirunavaara mining companies. Mr. Linnér will succeed the present manager, **Sven Frisell,** when he retires in January 1959.

Stanley A. Mahon, superintendent of the Weggum mine for the M. A. Hanna Company, has been transferred to Moose Mountain, 35 miles north of Sudbury, Ontario, to take over as superintendent of a low-grade iron ore property. **Lloyd Bredvold,** former South Agnew-Morton superintendent, will be in charge of the Weggum mine.

Edward A. Shulz, consulting geologist, and **William Clarke,** mining engineer, of the American Exploration & Mining Company, spent December in the Philippines examining a mining property on the island of Marinduque. The owner of the porphyry copper-type deposit is **Mr. Brooke Cadwallader** of Manila. A preliminary examination of the property was made for American Exploration & Mining Company by **Paul A. Schafer,** vice president and chief geologist of Philex Mining Corporation. American Exploration is a subsidary of Placer Development Ltd., which controls gold dredges in New Guinea and Colombia, and tungsten mines in British Columbia.

Sezai Cankut is now stationed at Istanbul, Turkey as metallurgist for Kursun Sanayii A.S., a lead smelting company.

W. B. Tobey, superintendent of Beaverhead County operations in Montana for Minerals Engineering Company, is currently on an inspection trip of the company's property in the Rhodesias, South Africa.

John Beattie has resigned his position as general manager of Delnite Mines to take over the position of executive director of the Ontario Mining Association in Canada. **Norman F. Parkinson** retired recently from the post which he has held since 1942; he was also executive director of the Mines Accident Prevention Association.

Bernard A. Bramson has been transferred from his position with the United States Embassy in Lima, Peru, where he covered mineral and petroleum activities on the west coast of South America, to the United States Embassy in Johannesburg, Union of South Africa. Brian Frisbie, former mineral attaché in Johannesburg, will take over the Peruvian duties.

Dr. R. E. Wimber and **M. McGrath,** United States mining consultants, are investigating the Milestone deposit in Australia for North Australian Uranium Corporation N.L. Their report will form the basis for the company's future mining operations.

Dr. Boris J. Kochanowsky of the mining department, The Pennsylvania State University, spent last summer in Germany continuing his research in blasting methods. He was invited to lecture at the School of Mines at Clausthal and the University at Aachen.

Robert O. Jones, manager of the Western Division of the Standard Slag Company in Gabbs, Nevada, visited mining operations in the Philippine Islands recently and also major steel plants and refractory producers in Japan.

Charles Smith, vice president and general manager of Atlas Consolidated Mining and Development Company, Philippines, was recently in the United States on a combined business and medical trip. Both of his arms were broken in a plane crash on Mindanao Island last September, but he is recovering rapidly.

Rollin E. Stevens, a specialist in geo-chemistry, has been named to the staff of the Union of Burma Applied Research Institute under a contract with Armour Research Foundation of the Illinois Institute of Technology, which undertook the reorganization in 1953 of the Institute at Rangoon.

MAURICE F. DUFOUR and FORBES K. WILSON have been elected vice presidents of Freeport Sulphur Company. Mr. Dufour, a graduate of Tulane who joined Freeport in 1933, is in charge of the company's nickel and cobalt interests. Mr. Wilson, a Yale graduate who came to Freeport in 1942, is manager of mineral exploration. Both men are also vice presidents of Nicaro Nickel Company, a wholly owned subsidiary, which is presently planning development of extensive nickel and cobalt deposits at Moa Bay in Cuba.

How a new **CAT*** No. 12 can

STEP UP YOUR MINE'S EFFICIENCY 3 WAYS

This new Caterpillar No. 12 Motor Grader maintains 16 miles of haul road and 'dozes truck spillage at the Hill-Trumbull Mine, Marble, Minn. It is owned by the Mesaba-Cliffs Iron Company and operated by the Cleveland-Cliffs Mining Company of Cleveland, Ohio. In building and maintaining haul roads for faster cycle times and reduced wear and tear on equipment, in 'dozing and clean-up work, the new Caterpillar No. 12 does a big and important job. Here is how it can do it at lower cost in *your* mine:

1. LOWER OPERATING COST. The new No. 12 delivers its 115 HP on non-premium, low-cost fuels. Its new oil clutch gives you longer clutch life, easier operation, and as much as 1500 hours between clutch adjustments. Tubeless tires (furnished at no extra cost) run cooler, last longer, and eliminate the tube and flap down time of old-fashioned tires.

2. LONGER WORK LIFE. Like all Caterpillar Motor Graders, the No. 12 is built—not just assembled—by a single manufacturer. This means traditionally sound Caterpillar ruggedness and workmanship, and careful balancing of engine and blade capacity for long life and high efficiency. And it means a single source for parts and service—your reliable Caterpillar Dealer.

3. INCREASED PRODUCTION. Positive, non-creep controls, easy "feel-of-the-road" steering, sure-footed traction with engine positioned over the driving wheels, quick-change blade positioning, unobstructed visibility—all these are good reasons why operators *like* the Caterpillar No. 12 Motor Grader, and do more efficient work on any job.

Your Caterpillar Dealer will demonstrate these and other features of the fast-working, long-lasting No. 12 Motor Grader. See him for proof that the Cat No. 12 will do more work at less cost on *your* job than any other grader.

Caterpillar Tractor Co., San Francisco, Calif.; Peoria, Ill., U.S.A.

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99% OF ALL CAT MOTOR GRADERS EVER BUILT ARE STILL AT WORK

$1,600,000 Project Starts At Cominco's Trail Plant

A $1,630,000 modernization program for a section of Consolidated Mining and Smelting Company of Canada's zinc department at Trail, British Columbia, has been started. The changes will be made in the section of the plant where high purity zinc cathode sheets are melted and cast into slabs for shipments. The job will involve installing newly developed techniques and equipment, and will take an estimated year and a half to complete. The plant is currently the world's largest zinc producer, recovering 520 tons of metal per day by electrolysis.

During a zinc enlargement program completed in 1952, Cominco installed a 300-ton electric induction melting furnace, the largest of its type. The furnace has operated successfully and the new program calls for installation of two 150-ton melting furnaces of the same type to replace oil-fired furnaces. Each of the new furnaces will be equipped with semi-automatic machinery for casting the zinc into slabs.

New gas filtering and dust collecting equipment will be installed. Improved storage and loading facilities will simplify shipping of the finished product. Working conditions and safety were emphasized in planning the project.

Hecla Sets Shaft Sinking Record for Coeur d'Alenes

A new shaft-sinking record for northern Idaho's Coeur d'Alene mining district was set by Hecla Mining Company at the Silver Mountain project east of Mullan.

The three-compartment vertical shaft was sunk 2,000 feet in less than 10 months for a 9.3 feet average daily advance. Three crews worked around the clock six days a week. Lee Messerly supervised the work in the joint venture with the Bunker Hill Company under an operating agreement with Silver Mountain Lead Mines, Inc.

The $1,058,366 Defense Minerals Exploration Administration project calls for crosscutting 1,200 feet north of the shaft and drifting 6,000 feet along a known mineralized zone.

Aluminum Ltd. Plans New French W. Africa Industry

An initial investment of about $100,000,000 will be made by the Canadian firm, Aluminium Limited, in its wholly-owned French subsidiary, Bauxites du Midi, for the creation of a new bauxite and alumina exporting industry in French West Africa.

A new industrial area will be formed about 345 miles southeast of Dakar and 185 miles northwest of Conakry in an undeveloped area of French Guinea, within the Boke region. The company plans construction of a chemical works with a capacity of 250,000 short tons of alumina a year; and also will build about 75 miles of railroad to the Atlantic Coast where new storage and port facilities will be established at the mouth of the Rio Nunex.

Since 1946 Aluminium Limited has invested about $2,000,000 for prospecting in the region and has located bauxite resources sufficient to warrent investment in the new project. The first bauxite is scheduled to be shipped in 1960 and the first alumina in 1961.

Bauxite du Midi has been operating in the Los Islands, off the mainland of Conakry, since 1952 and has mining, milling, and shipping facilities there which now produce and export about 500,000 tons of beneficiated bauxite a year.

Entirely independent of the new bauxite and alumina project, Aluminium Limited agreed last March to participate with the French aluminum producing company, Pechiney-Ugine, in the establishment of an aluminum industry in Guinea. This plan will depend on the hydroelectric potential of the Konkoure River which is now being studied.

Canadian Firm Starts Work on Arizona Claims

Four groups of claims in the Hassayampa district of Yavapai County, Arizona, have been consolidated for development purposes by the Abbican Mines, Ltd., of Toronto, Canada. Included are the Senator mine, the Cash, Snoozer and Ten Spot. Construction crews have started excavating for an all-steel 40- by 200-foot structure for the machine shop, powerhouse and warehouse; clean-up crews are putting in water and air lines and generally reconditioning the 14,000 feet of accessible tunnels; and plans call for immediate core drilling to explore the deposits at depth. The company hopes to be on a production basis with a 300- to 500-ton milling plant by mid-summer.

The Senator is credited with the production of over $500,000 in gold, principally from mining operations conducted by J. S. Douglas in the 1890's. Intermittent operations by lessees since then have yielded several cars of low-grade ore containing copper, gold, and silver. The Senator was held by Phelps Dodge Corporation from 1889 until two years ago when it was acquired by Jack Orr of Prescott and the late Ernest Dickie, who also owned the Cash, Snoozer and Ten Spot adjoining. They had made some shipments from the Cash and Ten Spot—principally copper ore with some gold and a little lead and zinc—but their plans for a consolidated operation ended with Mr. Dickie's death. Abbican is leasing the properties from Orr and the Dickie estate. Offices are maintained in Prescott with Robert Dannelly as company manager.

$33,000,000 Alumina Plant for British Guiana

A $33,000,000 processing plant with a capacity for producing 250,000 tons of alumina annually will be constructed by Aluminium Ltd. in British Guiana. Work on the plant will start shortly, with first shipments scheduled for 1959.

The new plant will be located on the northeast coast near Mackenzie, already one of the major bauxite centers. Ore will come from the company's operations in the Demerara River district of British Guiana at a rate of about 500,000 tons yearly. Demerara Bauxite Company, Ltd., a wholly owned subsidiary, is the operating firm.

Shipments are destined for aluminum plants at Kitimat, British Columbia or Arvida, Quebec, operated by the Aluminum Company of Canada, also a wholly owned subsidiary.

Rutile Interest Continues Strong In Australia; Government Agency Sounds Warning on Oversupply

The Australian Commonwealth Bureau of Mineral Resources has sounded a note of caution regarding the immediate future demand for rutile. The Bureau feels that so many new companies have been attracted to rutile production that demand may not match supply. A world consumption of 120,000 tons per year is forecast during the next two or three years, and Australia's share is expected to be about 95,000 tons, a figure that may be attained in the near future.

There has been a definite lull in recent buying, but this is attributed to two factors: most consumers have placed contracts for future delivery; many buyers, believing there will be greatly increased supplies of rutile, have tended to hold off from placing future orders. Established producers are not worrying, having sold most of their budgeted production for some years ahead at satisfactory prices. It is expected that demand for spot rutile will increase toward the end of this year.

Meanwhile, production continues at a rapid rate. Output of three leasing companies in New South Wales is estimated as follows: Zircon Rutile Ltd., at Byron Bay, 15,000 tons each of rutile and zircon; Associated Minerals Consolidated at Cudgen, 8,000 tons of rutile, increasing to 12,000 tons, and 9,000 tons of zircon. (This company recently refused a large offer from Titanium Alloy Manufacturing Company (subsidiary of National Lead Company) for leases; National Minerals Ltd. at Swansea, 7,500 tons of rutile and 7,000 tons of zircon.

Even Broken Hill Proprietary Company Ltd., huge Australian iron and steel producer, has fallen under the rutile spell. The company is testing beaches and large dune areas at Redhead, near Newcastle, where deposits are said to be low grade but large.

In Queensland, Hill 50 Central N.L. has closed drilling its Tewantin beach property and reports over 30,000 tons of rutile, 40,000 tons of zircon, and 2,000 tons of monazite. On Cape York Peninsula, permission to prospect over 60 square miles has been granted to Tweed Rutile and Minerals Pty. Ltd. who will explore for gold, tin, rutile, monazite, and manganese. This company is already prospecting 95 miles of beach from Cooktown on the eastern side of the peninsula to Cape Melville.

Investigations have been made of sea beaches in various parts of Tasmania without finding any significant rutile or other economic minerals. A recent examination of parts of the north coast by National Minerals, Ltd. was fruitless.

New Titanium Metal Plant To Use Improved Methods

An initial $40,000,000 will be invested by Allied Chemical & Dye Corporation and Kennecott Copper Corporation in a new jointly owned company to produce and sell titanium metal. The two corporations will share equal ownership.

Production of titanium tetrachloride, titanium sponge, and titanium billets will start in late 1958. Site and capacity of the plant will be announced soon.

A new continuous process, developed by Allied Chemical's Solvay Process Division, uses sodium to reduce titanium tetrachloride to titanium sponge. Most processes now in use are not "continuous." Allied Chemical has also worked out an improved process for the manufacture of titanium tetrachloride with titanium bearing slag employed as the raw material.

Kennecott's subsidiary, Chase Brass & Copper Company, Inc., has created new methods for melting and fabricating titanium which will be used in the plant. The new company is expected to undertake further pilot plant work and market development of an iodide process for the production of titanium with special properties.

The joint venture will be separate from Quebec Iron and Titanium Corporation, two-thirds owned by Kennecott and one-third by the New Jersey Zinc Company, which mines and processes iron-titanium ore to produce pig iron and titanium slag.

Titanium is a popular metal in the construction of high speed aircraft and guided missiles because, though light in weight, it is strong and holds its strength at increased temperatures. Within the last two years the price of titanium metal has been reduced from $5.00 to $2.75 a pound.

United Western Signs Another Farmout Contract

Newest of the recent farmout agreements made by United Western Minerals Company is one with Four Corners Exploration Company which provides for exploration and drilling on unpatented Federal Lode mining claims in McKinley County, New Mexico.

Under terms of the agreement, Four Corners will undertake drilling not less than a total of 10,000 feet of exploratory holes through the Westwater member of the Morrison Formation. Optional terms provide for either a straight royalty to United Western or a 50 percent working interest in mining which might result from the exploration program.

Interested with United Western Minerals in the farmout are S. Paul Dooley of Grants, New Mexico, and Roman Sandoval of San Mateo, New Mexico, both of whom own claims involved in the farmout area. Also parties to the contract are United Western's farmout partners, J. H. Whitney & Company, New York; White, Welt & Company, New York, and the San Jacinto Petroleum Corporation, a Delaware firm.

New Fluorspar Reserve Estimates Show Gain

Estimated Reserves of Higher Grade* Fluorspar in the United States as of October 1956

Location	*Measured and Indicated†*	*Inferred†*	*Total†*	*Approximate Percent*
Illinois, Kentucky	8,100,000	4,000,000	12,100,000	54
Colorado, Idaho, Montana, Utah, Wyoming	4,500,000	3,700,000	8,200,000	36
New Mexico, Arizona, Texas	800,000	700,000	1,500,000	7
California, Nevada, Washington	400,000	350,000	750,000	3
New Hampshire, Tennessee, Alaska	—	10,000	10,000	—
	13,800,000	8,760,000	22,560,000	100

*Fluorspar containing at least 35 percent CaF_2 or equivalent.
†Short tons of crude ore.

New estimates of United States fluorspar reserves have been made for the Office of Minerals Mobilization by the United States Geological Survey. These reserves are now estimated to total about 22,500,000 short tons containing 35 or more percent CaF_2 or the equivalent value in combined fluorspar and metallic sulfides. About 61 percent of the 22,500,000 tons is measured and indicated ore; the remainder is inferred ore (see table). This estimate compares with the Survey's previous estimates of 17,500,000 tons in 1954 and 15,000,000 tons in 1952, and with the Geological Survey-Bureau of Mines estimate of 14,500,000 in 1945. The geographic distribution of the higher grade reserves, expressed in terms of crude ore, is also shown in the table. In general the major reserves are concentrated in the major producing districts, the Illinois-Kentucky district accounting for about 54 percent. Of the 250 deposits in the United States for which reserves were estimated, 50 deposits contain 77 percent of the ore reserves. The reserves of mixed fluorspar-sulfide ore included in the estimates for higher grade fluorspar ore total about 7,000,000 tons. Ores of this type are found in the Illinois-Kentucky district, where they average three percent zinc, and in the Jamestown district, Colorado, where they average about 0.5 percent lead. Approximately 1,000,000 tons of the zinc-bearing ore in the Illinois-Kentucky district contains about one percent lead. Nearly all the higher grade reserves are believed to be amenable to beneficiation into acid-grade and metallurgical-grade concentrates. From an investigation of analyses and the physical nature of the ore, it is not possible to predict whether a deposit eventually will yield acid-grade or metallurgical-grade concentrates; the type of end product depends almost entirely upon the relative prices, demands, and owner's need for the different grades.

U.S. Sulphur Output Set New Records in '56

Production and consumption of sulphur in the United States reached new highs in 1956 when output of sulphur from all sources increased to an estimated 7,875,000 long tons, or 825,000 tons more than in 1955. Consumption of sulphur in the United States was estimated at 5,900,000 tons compared with 5,650,000 tons in the previous year, and exports were expected to about equal the 1,600,000 tons shipped in 1955.

More than four fifths of the total production came from the salt dome deposits of Louisiana and Texas. These deposits, which are mined by the Frasch hot water process, produced an estimated 6,450,000 tons compared with 5,750,000 tons in 1955. Of the balance of the supply, 500,000 tons represented sulphur recovered from gases, 425,000 tons sulphur contained in pyrites, and 500,000 tons sulphur in various forms from other sources.

Thirteen Frasch process mines operated during the greater part of the year. Texas Gulf Sulphur Company, the largest producer, operated three in Texas; Freeport Sulphur Company, four in Louisiana and one in Texas; Jefferson Lake Sulphur Company, two in Texas and one in Louisiana; and Duval Sulphur and Potash Company and Standard Sulphur Company one each in Texas. In November, Freeport closed its small Nash mine located 35 miles southwest of Houston.

The development of two new mines—the Lake Pelto, Louisiana, property of Freeport and the Fannett, Texas, deposit of Texas Gulf—was under way in 1956 and plans to mine an additional new deposit, known as Grand Isle—Block 18, were announced.

Ambrosia Lake Awakens With Shaft Sinking

Ambrosia Lake, New Mexico, with its millions of tons of drilled out uranium ore, is slowly being brought into production. Rio de Oro Mines Company, the first and only producer to date, in association with Homestake Mining Company and other partners, continues nominal production for shipment to the United States Atomic Energy Commission's Grants purchase depot. Surface drilling has increased reserves and ground will be broken this spring for a mill to treat the ore.

Second company to get into actual production will probably be Kermac Nuclear Fuels Company from Sec. 10, T. 14 N., R. 10 W. where Patton and Gallasini, Bayard, New Mexico contractors, are sinking a shaft. This is the westerly extension of the Rio de Oro ore body. No difficulties are foreseen in getting into production.

Two major shaft sinking contracts have recently been awarded for shafts south and southeast of Rio de Oro. These will be big shafts to depths between 800 and 900 feet. Boyles Brothers Drilling Company of Salt Lake City, Utah has contracted the Phillips Petroleum Company shaft to mine ore in Secs. 28, 34, T. 14 N., R. 9 W. Centennial Development Company of Eureka, Utah will sink the Homestake-Sabre-Pinon Group shaft.

The sleeping uranium giant—Ambrosia Lake—slowly stirs toward life.

Iron Ore Miners Learn Blast Furnace Operators Views at Duluth Symposium

A long careful look at blast furnace raw material needs highlighted the 18th annual Mining Symposium sponsored by the University of Minnesota at Duluth, Minnesota early in January.

The theme, "Ore Characteristics as Factors in Blast Furnace Feed," set the stage for two days of intensive discussions by outstanding blast furnace operators. Generally speaking, the recognition of the declining grades of iron ores and the greater use of pellets and sintered materials in blast furnaces gave the record size group much to consider in their never-ending battle with quality control in the ores shipped down the lakes.

Furnace Men Give Their Views

The University did a tremendous job in gathering together a dozen or so of the top blast furnace experts who presented the case for the steel companies on just what they need for increased blast furnace production under the stresses and strains of rising operating costs and ever tighter product quality requirements.

The opening session was presided over by George P. Hansen, assistant vice-president in charge of steel plants, Wheeling Steel Corporation, who set the stage for the papers which followed.

Professor T. L. Joseph of the University of Minnesota, who is recognized as one of the outstanding authorities on the subject, covered the ground on the detailed technical problem of "The Importance of Gas-Solid Contact in Blast Furnace Operation." His paper led the way to the later discussions of sized material, sinter product, and other subjects pertinent to the need for ever better feeds for blast furnace operation.

Richard Wilson, assistant blast furnace superintendent of the Inland Steel Company, then discussed the "Effect of Particle Size in Blast Furnace Operation." He pointed out that furnace production has increased considerably by using sized and sintered material as feed. His studies have shown that blast furnace operations have been much improved and the production greatly increased by increasing the burden of material carefully sized and by increasing the amount of sintered ores in the furnace charge.

A. H. Fosdick, superintendent, blast furnace division, Bethlehem Steel Company, also spoke on the "Use of Sized Ore and Sinter in Blast Furnace." He pointed out that there are presently four methods of treating fines—sintering, pelletizing, nodulizing, and briqueting. Of the four, sintering has grown by leaps and bounds. The total capacities of the various companies have grown to meet the need for increased pig iron and to utilize the fines and flue dusts which pose a considerable production problem.

Ray Sundquist, division superintendent, Blast Furnaces, United States Steel Corporation, Gary, Indiana, reported in some detail on United States Steel studies of "100 Percent Sinter Burden in Blast Furnaces at Gary." He stated that blast furnaces can be operated efficiently with 100 percent sinter but the need is for more sinter product all along the line. His studies show that more iron is produced at a lower coke rate which has a major bearing on the costs of producing a ton of pig iron.

R. P. Liggett, chairman, blast furnace committee, Republic Steel Company, discussed the "Experience With Labrador Ores for Blast Furnace Use." He pointed out that the greatest upsurge of ore preparation this country has ever seen is due largely to the present great demand for pig iron. He feels that 50 percent of 1957 furnace needs will be a sintered ore of one kind or another.

Why Silica Must Be Low

In the course of his discussion, the matter of silica content in iron ores was covered and a rather interesting set of figures was set forth. Liggett pointed out that low silica content was a must and that the foreign ores were now very low in silica. He said that he figured that 1.0 percent more silica meant 84 pounds more limestone, 39 pounds more coke, and 89 pounds more slag per ton of ore in a blast furnace. He made the comment that each 1.0 percent of silica set up a penalty of about 57.5 cents per ton, about half of which could be chargeable to the need for greater open hearth scrap purchases.

At this point Mr. Cope made the comment that his review of the subject showed that when the furnace burden is 40 percent sinter or more there is an accompanying 10 percent increase in iron output and a 10 percent less coke rate.

In general, both Mr. Cope and Mr. Liggett seemed to feed that improved ores mean more iron, less lime, and less coke, and this will run as high as 15 percent better depending entirely upon local situations and conditions.

J. H. Strassburger, assistant vice president, National Steel Company, discussed the "Economics of Ore Quality in Blast Furnace Practice." He opened the discussion by stating that the present scrap supply is getting less and less and that it is constantly declining in quality. Thus, he points out, the use of more pig iron is an economic necessity.

The second day's meeting was devoted to a panel discussion of "Agglomeration Processes and Their Significance for Lake Superior District Iron Mining." Here again, the need for sintered material was stressed, and again it was brought out that the need for treated ores seemed to be the greatest for increased furnace output. In 1956 the United States has 38,000,000 annual tons of sintering capacity and in 1959 that capacity will have increased to 60,000,000 tons. By that time there will be in operation several sintering machines 144 inches in width. One member of the panel seemed to feel that the constantly improved pellet product will be better than sinter, although another panel member stated flatly that either pelletizing or sintering depend almost entirely upon the local conditions. An interesting fact cropped up in this portion of the discussion when the question was asked, "What breakage factor is there in the shipping of pellets?" The panel member to whom the question was directed stated that the maximum breakage to fines was only about 8 percent and that was after several handlings. In discussing the breakage of regular ores the fact came out that the loss to fines in shipment was generally low but many of the ores broke badly in shipping.

Thus, there were two days of discussions of the ways and means of how both ends of the iron industry can work more closely together. The problems of increased costs at the steel mills directly affects the operations in the mines and as each year goes by both feel the need of ever closer cooperation in matters of quality, tonnages, and grade.

AIME Hears About Reserve

The Symposium was preceded by a one-day meeting of the Minnesota section of the AIME which program set the tone, as it were, for the whole three days.

The second part of this program was a close and detailed look at the Reserve Mining Company's taconite operations. F. W. Erickson, manager, Babbitt Division; E. M. Furness, superintendent, crushing and concentrating; and K. M. Haley, superintendent, pelletizing, gave detailed papers on the various phases of the Reserve operations. At present Reserve is turning out 12,000 tons per day of pellets and expects this tonnage to be increased before too long.

Thus, the annual gathering of the iron-mining clan to exchange ideas, to promulgate new programs, and to get a running start for the new year's program has drawn to a close. As always it seems that never was there a meeting like the one just finished, but each year new ideas and new problems arise demanding answers which will satisfy the industry. So, such a "town meeting" of the industry produces much of value to all.

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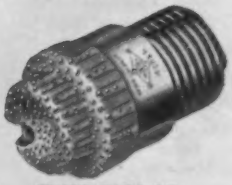

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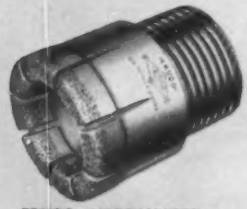

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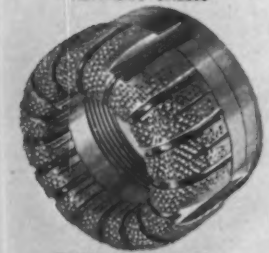

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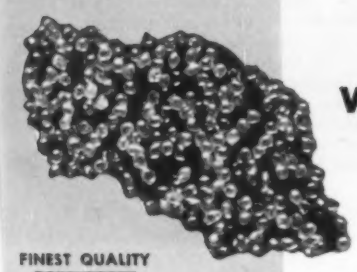

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Carats used DOWN 22.4%

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The analysis showed that the pilot type, non-coring bit delivered highest footage, highest diamond salvage and lowest cost per foot drilled. It also indicated the advantages of working with *one* manufacturer in developing a bit tailor-made to the job. The Truco bit was adopted and developed through progressive stages of improvement to the present level of performance which is remarkable by any standards.

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And, if drilling costs are your responsibility, maybe you should talk to the Truco Diamond Drill Bit man. Very likely he can help you.

Year	Footage Per Bit	Carats Used Per Foot Drilled	Salvage	Cost Per Foot Drilled	Cost Per Ton
1st	3630	.00089	67.7	0.0122	.0065
2nd	4930	.00085	68.1	0.0111	.0041
3rd	4300	.00084	69.6	0.0110	.0032
4th	5590	.00069	67.7	0.0076	.0022
	UP 54%	DOWN 22.4%		DOWN 37.7%	DOWN 66%

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Air Research and Development Command at Wright-Paterson Field, Ohio has awarded a contract to *Horizons, Inc.* of Cleveland, Ohio for fundamental research in the field of rare earths. Work will be under the supervision of Dr. Ronald C. Vickery. Horizons also has a 1-year contract from the Navy Bureau of Aeronautics for development work on a commercial method for producing titanium by an electrolytic process. (See MINING WORLD, September 1956, page 140.)

Six technical papers on ceramics have been announced for a symposium on alumina source materials in glass, to be held by the Industrial Minerals Division February 25, 1957, at the New Orleans, Louisiana national convention of the *American Institute of Mining, Metallurgical, and Petroleum Engineers*. They are: "The Use of Alumina in Glass", by E. W. Summers, *Owens-Illinois Glass Company*, Cleveland; "Flotation Feldspar", by Carroll Rogers, Jr., *Feldspar Corporation*, Spruce Pines, North Carolina; "Dry Processing of Feldspathic Pegmatite" by H. B. DuBois, *Golding-Keene Company*, Trenton, New Jersey; "Nepheline-syenite", by H. R. Deeth, *American Nepheline, Ltd.*, Lakefield, Ontario; "Aplite", by V. V. Kelsey, *Dominion Materials Division*, Piney River, Virginia; "Other Source Materials", by R. W. Hopkins, *Calumite Company*, Hamilton, Ohio.

The *Bureau of Mines* has issued a report dealing with its reasearch program at the Mississippi Valley Experiment Station at Rolla, Missouri, where efforts are being made to develop improved magnesium alloys. Goal of the continuing program is to create more corrosion-resistant, more ductile, and stronger alloys of this lightest of structural metals. Studies have included creation of binary (two-metal) and ternary (three-metal) alloys. After unpromising experimentation with nickel and nickel plus manganese as alloying metals, Bureau researchers turned to lithium. They have found that an alloy of 90 percent magnesium and 10 percent lithium, by weight, is ductile and malleable, but lacks strength. Addition of aluminum was tried, but did not solve the strength problem. Preliminary examinations show that cerium, antimony, or silicon give sufficient promise to merit additional tests which will be described in detail in later publications as research progresses.

The *Bethlehem-Cornwall Corporation*, a division of the *Bethlehem Steel Company*, has completed sinking of its two vertical shafts at the *Grace* mine near Morgantown, Pennsylvania. Production is expected to start sometime in 1958. Three levels are now being driven at depths of about 1,800, 1,900, and 2,000 feet. A pelletizing plant is also being erected.

Tennessee Copper Company is sinking a new shaft—the "B" shaft—at its *Calloway* mine at Copperhill, Tennessee. Completion of the shaft and such installations as hoisthouse, headframe, ore bin, and railroad spur, are expected by the end of 1957. Calloway underground ore bodies have been under development for several years and there has been a gradual increase in the production tonnage. Under an operating plan worked out several years ago, the Mining Department sank a 12-foot-diameter shaft from the 10th level of the Calloway mine down to the 24th. The plan was then to hoist ore from the lower part of the mine up to the 10th level and then over to the Central shaft for delivery to the surface. Diamond drilling near the lower levels of the underground shaft had been continuing, however, and it was revealed that the ore body was larger than originally expected. Engineering studies concluded that it would be better to extend the underground Calloway shaft to the surface directly, and this is the work now being done.

Though final figures have not been released, it appears that purchasing of mica at the *U.S. Mica Purchasing Depot* at Spruce Pine, North Carolina totaled close to $3,000,000 in 1956. Deliveries to the depot in 1957 are expected to bring an increase of about 25 percent. Two unusually rich mica blocks were sold to the depot recently. Frank Phillips of Spruce Pine uncovered a 275-pound block in the old *Hawk* mine on Cane Creek in Mitchell County, which brought a preliminary payment of $2,006. The *Southern Mica Company, Inc.* found a single 49-pound block in the old *Barron* mine near Thomasville, Georgia which brought $892, or an average of $45 a pound. The firm is cleaning out the old open-pit mine in preparation for shaft sinking.

Geologists of the *New Jersey Department of Conservation and Economic Development* reportedly have made a second discovery of ilmenite within the state. The previous find was made at Chester in Morris County, in September 1955. The present discovery is located in South Jersey. Fourteen boreholes had disclosed a relatively high percentage of ilmenite. Analysis of mineralization in three of the holes averaged from 3.05 percent to 8.9 percent. Additional determinations will be made.

Foote Mineral Company has purchased a ceramic grinding mill and feldspar deposits in the vicinity of Cold River, New Hampshire. The mill was formerly owned by *J. F. Morton, Inc.*, a feldspar producer. George B. Kneass, Jr., formerly with Foote's plant at Exton, Pennsylvania, will head the new plant operation in New Hampshire.

Titanium Metals Corporation of America has purchased from the *Louis Berkman Company* its Ohio River Steel Division plant at Toronto, Ohio, 60 miles west of Pittsburgh. The firm plans to convert it into the first specialized facility in the nation for rolling and forging titanium. Until now, steel mills have been converting the titanium ingots into mill products. TMCA is owned jointly by the *National Lead Company* and *Allegheny Ludlum Steel Corporation*. It recently announced expansion of its titanium sponge plant at Henderson, Nevada from 6,000 tons to 9,000 tons yearly, and an 80 percent increase in titanium ingot capacity to 11,000 tons yearly.

Hobart Brothers Company reports it has developed a giant, bucket-type dredge for mining of titanium in Florida. The new dredge will handle enough sand to produce 200 tons of titanium a week; the suction type dredge now in use handles only half this amount, according to Edward A. Hobart, president. The firm has been working on titanium production at Winter Beach, Florida, 200 miles south of Jacksonville, for four years.

Paul Hoppes, Lin Carpenter, and John Phillips, all of Spruce Pine, North Carolina, are developing a mica property at Albany, Maine, about 20 miles west of the Norway-South Paris area. A crew of eight men are said to be mining about two tons a week. They operate in three headings off the main tunnel, and are starting a second shaft. A dike 787 feet long has been exposed.

Production of zirconium will be increased 100 percent at the *Allegheny Ludlum Steel Corporation* plant at Watervliet, New York because of the installation of a new furnace for melting high purity zirconium. The furnace can produce a 2,200-pound ingot and has a rated capacity of 50,000 pounds per month. An even larger furnace is under construction and will be in operation shortly, increasing ingot capacity to 125,000 pounds per month.

Copper from foreign countries is once again entering the Port of Baltimore for refining in *American Smelting and Refining Company's* Baltimore plant after a lapse of 12 years. Mexico and Turkey are the principal foreign sources. The bulk of the Mexican ore comes from ASARCO's own holdings in Mexico. Normally, principal copper source for the Baltimore plant is blister from domestic smelters in Utah, Nevada, and Arizona.

The *Chesapeake & Colorado Corporation* has leased a 1,100-acre tract near Bowditch in Yancey County, North Carolina and has options on other properties in this mica region around Spruce Pine. A 500-ton ore separation plant is under consideration, and it is reported that design of the plant is being worked out by *Vitro Corporation* of New York.

Oliver Iron Mining Division of the *United States Steel Corporation* has transferred its lease on the *Godfrey* mine near Chisholm, Minnesota to the *Snyder Mining Company*, owned by *Shenango Furnace Company* and *Crucible Steel Company*. Snyder plans to reopen the mine in the immediate future and will use the Godfrey hoist system to bring ore from the *South Tener* mine, an adjacent mine owned by Snyder, as well as from the Godfrey lease. The mine had been operated on a lease basis by Oliver from 1927 to March 1955.

Pickands, Mather & Co., consultant for *Ashland Mining Company* at its low-grade iron ore property at Butternut, Wisconsin, has begun test work and pilot plant work at Hibbing, Minnesota to determine a successful flowsheet for recovery of iron in the deposit. Before

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winter set in a trench was dug across the deposit and the material loaded for transportation to Hibbing by railroad cars.

Jones & Laughlin Steel Corporation, Pittsburgh, Pennsylvania, has awarded a preliminary engineering contract to *Western-Knapp Engineering Company* of Hibbing, Minnesota, for design of the Lind Greenway concentrator near Grand Rapids, Minnesota.

Oliver Iron Mining Division of *United States Steel Corporation* completed the longest ore season in its 64-year history by shipping over 30,000,000 tons of iron ore and concentrate in 1956. The season had been hampered by the steel and shipping strikes which lasted 70 days during July and August. Included in Oliver's 1956 Minnesota ore production were over 5,000,000 tons of high-grade iron ore concentrates procured from taconite and low-grade ores. Seven beneficiation plants produced the concentrates from crude ores mined chiefly on the western Mesabi and from taconite mined at Mountain Iron.

Cleveland-Cliffs Iron Company has requested permission to obtain 5,300 acres of state-owned property in Marquette County, Michigan in exchange for a deed to company property of equal value in some other area. Cleveland presumably plans another low-grade iron ore project.

The week of December 23rd brought the 1956 shipping season on the Great Lakes to a close with a total of 77,633,027 tons, or about 10,000,000 behind that of last year when the season closed on December 8 with 87,459,853 tons. The season closed later than usual because *United States Steel Corporation's Pittsburgh Steamship Division* kept a majority of its 57-boat fleet in operation. The last three cargoes loaded at Two Harbors, Minnesota, totaling 59,006 gross tons, were loaded by Pittsburgh Steamship Division. Other shippers had ceased operations about three weeks before.

Lake Superior & Ishpeming Railroad will construct an iron ore loading facility on Little Bay de Noc on Lake Michigan in the vicinity of Rapid River, Michigan. This will include necessary rail facilities to reach that location. The decision to establish this facility was largely due to the demand for iron ore at Chicago. Another factor was the development of low-grade ores and their pelletization. A pelletizing plant at Eagle Mill was recently completed, and it is expected that production of pellets will increase rapidly in future years. The new dock will be a belt conveyor type, and should eliminate breakage in handling of iron ore pellets which occurs when handled in a conventional type dock. A contract is being prepared to purchase a one-half interest in the Soo Line from Eben to Rapid River to facilitate this movement.

Construction of the *Mahoning* mine beneficiating plant for the *Pickands Mather & Co.* near Hibbing, Minnesota continues. This plant will include a straight washing section, conventional heavy media section, heavy media cyclone section, and a Humphrey spiral section. It is scheduled for operation in May, 1957.

The *Snyder Mining Company* is continuing diamond drilling in the Butternut, Wisconsin, area, which is also being explored by *J & L Steel Corporation* and *McCloth Steel Company*. This deposit is believed to be an extension of the Michigan Gogebic Range.

Swinerton & Walberg of San Francisco, California have taken over the contract for construction, maintenance, and related services for the *United States Atomic Energy Commission's* office at Grand Junction, Colorado. The firm succeeds *Walker-Lybarger Construction Company* of Grand Junction which has supplied these services since 1948. Selection of the firm was made after study of 10 proposals, including one by Walker-Lybarger. The contract runs for 2½ years.

The joint *Boyles Brothers Drilling Company-Calamity Creek Uranium Corporation* venture on Calamity Mesa, Mesa County, Colorado, has delineated 4,500 tons of ore, according to recent reports. The property is expected to start producing uranium-vanadium ore toward the end of this year.

DMEA contracts were awarded recently to the following Colorado operations: Lee E. Cox and T. R. Gillenwaters, $19,960, to search for uranium in Mesa County; *Monarch Exploration Company*, $55,580, for uranium in Saguache County; *Vulcan Silver-Lead Corporation*, $160,369, for uranium in Saguache and Gunnison Counties; and Jesse A. Bingel, $28,010, for tungsten-lead-copper in San Juan County.

National Minerals Corporation of Chicago, Illinois is reported to have purchased the stock of the *Superior Mines Corporation* of Colorado. The latter owns the *Rawley* mine at Bonanza, Colorado.

Denver-Golden Oil & Uranium Company has resumed regular shipments of uranium ore from its operations near Golden, Colorado after completing sinking of the Ladwig shaft and drifting on the ore body. The company is also developing the *Schwartzwalder* mine four miles away. The new Charlie Tunnel has been driven 450 feet. This tunnel is 110 feet below the first tunnel still being worked by the firm. Production from this operation is expected to continue at about 1,500 tons monthly, with shipments going to Vitro's plant at Salt Lake City.

Approximately 8,160 acres of public land in the Slick Rock district of San Miguel County, Colorado, which had been withdrawn from location of mining claims in July 1954, have now been released. The land had originally been withdrawn upon an AEC application filed with the Bureau of Land Management. Persons interested in prospecting and locating mining claims in the area are urged to check the records of the Land Office, Bureau of Land Management, in Denver, Colorado to be certain that there are no prior claims or other restrictions.

Williamson and Son are producing fluorspar from the *Emmett* mine in Jamestown, Colorado for *Ozark-Mahoning Company*. It is milled at the company's mill in Jamestown, and then hauled to Boulder for shipment. Development is going on underground, and a new pit for surface mining was opened within the last few months. The pit furnishes about one-half of the tonnage for the mill and the rest comes from underground. Production is 100 tons per day.

T. J. Henning, Merle Rugg, and Joe Smith are reported to have located an orebody on the *Longshot* claims at Nederland, one-half mile from *Cold Spring Tungsten, Inc.'s* mine. Jim Pastore is placering on ground belonging to Cold Spring and reports good progress.

Another 2,000 tons of uraniferous lignite has ben ordered by the AEC from western North Dakota for metallurgical testing at the Grand Junction, Colorado pilot plant. Of this amount, *Landis-Gress-McCann-Getting* will provide 500 tons; *Northgate Uranium*, 500 tons; and *Ohio Oil*, with headquarters at Dickinson, 1,000 tons. The Landis and associates' deposit is located on the *Smith Lease* near Belfield-Fryburg. Ore is covered by only five to six feet of sand overburden. *Dick Law Construction Company* did the stripping and mining.

A crew of the *Burmac Uranium Company* recently began exploration operations on the firm's leased land in the Carlyle-Ollie areas west of Beach, North Dakota, and on both sides of the Montana-Dakota line. *Munson-Chandler Corporation* also has been coring on its leased land on Square Butte. Heavy equipment has been used to build a road to the top of the Butte, passable only for trucks and jeeps.

A group from Wahpeton, North Dakota reportedly are experimenting with a portable uranium mill. Their firm is the *Otter Tail Industries*, and Philip W. Peter is president. They plan to use the process on low-grade lignite near Gillette.

Recently incorporated at Custer, South Dakota was the *Black Hills Development Company* by Patrick and Shirley Robuck, and Robert C. Bakewell, Jr.

Montana Chemical and Milling Corporation of Edgemont, South Dakota reports it has a substantial uranium-bearing ore body on its property. Matt Brown is president of the firm. Operations initially will be by open pitting, but deeper mining of the primary ore is planned at a later date.

McFarland & Hullinger are reported to have taken over operation of the *Gismo* uranium mine near the *Happy Jack* mine in San Juan County, Utah. The owners are Donald Blake and Milton Neilson.

Continental Uranium, Inc. of Grand Junction, Colorado, has completed large-scale stripping of the *Rattlesnake* open mine uranium mine in San Juan County, Utah. November production exceeded 2,500 tons; December was about 3,000; output is expected to be gradually increased to about 5,000 tons per month. The ore is shipped to the *Climax Uranium Company's* mill at Grand Junction.

Consolidation of *Atlas Uranium Corporation* and *Bleak Uranium Company*, with Atlas as the surviving company, has been approved by stockholders. The merger brings the *Piccolo Pete* uranium claims in White Canyon, Utah, and other Bleak assets into the Atlas holdings. An application for a DMEA loan to aid in further exploration of the Piccolo Pete group is pending. Major Atlas operation at present is a new lead-silver-zinc mill at Crested Butte, Colorado which is treating ore at the rate of 50 tons per day from Atlas properties in that area. The mill will be increased to 100 tons per day capacity next spring, say company officials.

The *Utah Geological and Mineralogical Survey* has issued a new "Geologic Atlas of Utah—Emery County," Bulletin 52. This comprehensive atlas, in color, is streamlined for maximum usefulness for uranium prospectors, oil geologists, nature students, campers, and tourists. Although the entire surface of the county has been mapped geologically on a large scale—½ inch equals one mile—the atlas has no loose maps, "tip-ins" or pouches at the back to encumber the user. This bulletin is the first unit of an ambitious plan by the department and sells for $5.00. Write to the Survey at the University of Utah, 200 Mines Building, Salt Lake City 1, Utah.

Twin Star Industries, after 35 years of activity in the lignite field in North Dakota, has expanded its mining operations to include uranium in the Four Corners area near Monticello, Utah. The property, known as the *Lodestar* mine, has been reequipped and additional shafts are being completed.

Western Development Company of Denver, Colorado, is currently exploring the *Cottonwood* claims it acquired when it took over the *Excalibur Uranium Corporation*. These claims are on the east side of the Green River opposite the Bow Knot, where a promising ore channel has been exposed. In advancing the tunnel on this channel, some shipping grade ore has been mined and operations will be expanded if the ore persists.

Columbia-Geneva Steel Division of the *United States Steel Corporation* may construct a processing plant at its large iron ore prospect near Lander, Wyoming if tests now under way indicate a feasible operation. Considerable test diamond drilling has been done to a depth of 750 feet and an adit for bulk sampling is now being driven. Samples and a 100-ton test shipment are now undergoing testing. Worrel F. Pruden, Columbia-Geneva's chief engineer, described the deposit as a taconite type similar to low-grade Minnesota deposits now under development. This would require extensive treatment

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at the mine before the concentrate could be shipped to the Columbia-Geneva mill at Provo, Utah. Development of the property would probably require construction of a 40-mile spur line from the main Union Pacific Railroad line near Point of Rocks, Wyoming. Union Pacific crews made surveys of possible routs this past summer.

Vitro Minerals Corporation, under a contract with *Out West Uranium and Oil Company* of Denver, Colorado, has completed more than 22,000 feet of drilling on the *Jay* claims in the Gas Hills district of Wyoming. An additional 25,000 feet of drilling has been allocated to these properties to complete the blocking out of known ore bodies. Indicated ore reserves are now in excess of 50,000 tons and inferred reserves exceed 100,000 tons. The property lies between the operating mines of Vitro and *Lucky Mc-Utah Construction Company*.

Despite winter weather, *Veca Minerals Company* of Riverton, Wyoming has opened a uranium stripping operation in the Gas Hills area. The large pit has been stripped to a depth of 45 feet, with about 3,000 tons of ore stockpiled. Shipments have begun to the buying station at the *Lost Creek Oil & Uranium Company's* mill near Crooks Gap. Some 90,000 tons of ore reportedly has already been blocked out, with shipments expected to average 0.30 percent U_3O_8. The property is surrounded on three sides by producing mines of *Shoni Uranium Corporation*, *Aljob Mining*, and *P-C Mining*.

Vitro Minerals Corporation, largest uranium producer in the Gas Hills area of central Wyoming, has requested permission from the AEC to construct an ore upgrading plant at the mine. It was described by W. B. Hall, Vitro general manager, as basically the "front end" of a uranium mill, upgrading ore to about 10 percent U_3O_8. The concentrate would then be shipped to Vitro Uranium Co.'s processing mill in Salt Lake City for further treatment. Virto reported that with the upgrader and a small addition to its present personnel it would be able to mine some 10,000 tons per month. Its present AEC quota is 1,500 tons. The upgrader would also permit profitable mining of what is now sub-marginal ore.

A five-man crew from the *Bureau of Land Management* is working in the Crooks Gap area in Central Wyoming, making the first examination of mining claims in the State under provision of the Multiple Use Law. The crew is examining hundreds of uranium claims in the area, checking on surface values not of value in connection with actual mining operations.

The *Wyoming State Land Board* has approved the first request in the State for unitization of tracts of land for a mining operation. The application was submitted by *Intermountain Chemical Company* for its trona mining operation near Green River, Wyoming. The company proposes to inject heated chemicals under pressure into the trona beds, some 1,500 feet below the surface, then pump the dissolved trona to the surface. The company plans to use the system in a nine-section tract. The agreement, similar to that used in the oil industry among royalty holders and the company, would allow production and payment of royalties on a pro rata basis. The firm's operation is the only place in the world where naturally occurring trona is mined.

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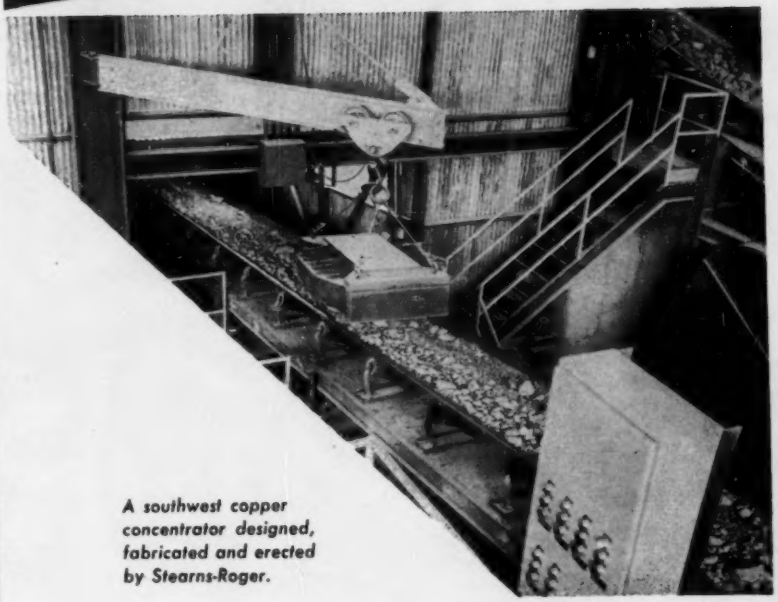

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The first carload of copper ore from the *Minor* mine of the *U. S. Consolidated Mines, Inc.*, near Mayer, Arizona, has been shipped to the Hayden smelter of *American Smelting and Refining Company*. An extensive development program has been in progress at the Minor during the past year, with present work on the 250-foot level. Lou Donderea of Mayer is superintendent and has been employing about 12 men. Plans call for a considerable increase in the crew after the first of the year.

Construction of a 19-mile 115,000-volt powerline is almost completed in the Ray-Hayden area of Arizona. Purpose of the new line is to provide power for *Kennecott Copper Corporation's* new smelter at Hayden. It is being run from the Ray Substation to the Hayden Substation at a cost of approximately $250,000. Kennecott's load is expected to be about 27,000-kva. The 60-cycle power is supplied by Salt River Power District over the 115,000-volt line from the Mesa Switching Station through the Superior Substation.

Frank A. Crampton of Willows, California, is completing plans for taking over the old *Wren* mine near Wickenburg, Arizona. The property is an old prospect owned by C. L. Maguire. Reports indicate a small tonnage of high-grade copper-gold-silver ore is available for stoping. Mr. Crampton plans to mine this ore while a more thorough examination of the property is in progress.

Eugene A. Fredericks, president of *U. S. Consolidated Mines, Inc.*, Prescott, Arizona, has announced that his company has entered into an agreement for the mining and milling of its manganese ore deposit by the *Ambrosia Minerals Company*. The ore will be up-graded to meet government specifications for shipment under the carlot program. U. S. Consolidated's property is near Aguila, Arizona, about 4.5 miles from Ambrosia's mill.

Bayshore Mining Company of Corpus Christi, Texas is producing uranium ore from two mines located about 10 miles east of Holbrook, Arizona. The properties are known as the *Barton* and *Rock Gardens* areas. Bayshore and another firm, *Black Nugget Uranium*, have both drilled the district along the Little Colorado River from Winslow to St. John's. *Tidewater Oil Company* is also reported to have done some work in the same area.

Coso Uranium, Inc. of Long Beach, California is reported to have signed a contract with an unidentified Los Angeles group for additional exploration and development of the firm's 520-acre property in the Coso Range 10 miles east of Olancha, Inyo County, California. About eight shipments of uranium ore were made to *Vitro Uranium Company's* mill at Salt Lake City, Utah but the shipping cost proved mining to be uneconomical. If the new exploration program indicates sufficient ore, the company will consider the possibility of processing the ore nearer to the mine.

The new management of *Natomas Company* plans to offer its dredging equipment on a contract basis to mining operations in other regions rather than sell it. The company owns eight dredges, five of which are idle. The remaining three are dredging gold properties in California which should be depleted in six or seven years. Natomas hopes to gain participation in other mining ventures, possibly on other continents, by offering this equipment it believes suitable for tin, diamonds, and other mineral recovery.

The DMEA recently awarded the following contracts for exploration in California: Smith and Biaggini, $11,060, for mercury exploration in San Luis Obispo County; Murray A. Schutz, $28,540, for mercury in Yolo and Napa counties.

The *Black Bear Consolidated Mining Company* of San Francisco, California has purchased 13 new claims and acquired stock in the *Tonopah 76 Consolidated Mining Company*. The claims are in the Marysvale, Utah uranium district, giving the company a total of 32 in that area now. The Tonopah stock purchase makes Black Bear the largest individual stockholder in that firm. Black Bear bought the stock partly for cash, and partly by exchanging ownership in the *Sweden-Norway* copper mine located in Washington.

Frank A. Crampton of Willows, California has written a book about his experiences in the old western mining camps from Cripple Creek, Colorado to Death Valley, California. "Deep Enough" is the title, and it presents a fine picture of the life of a hard rock miner from 1902 to 1920.

Consolidated Virginia Mining Company's chrome producing subsidiary, *Hampton Mining Company*, has made an arrangement whereby chrome ore can now be shipped to Coalinga, California from the firm's property near New Idria, San Benito County, California at regular Grants Pass, Oregon buying depot prices without paying the extra long haul charges that were formerly assessed. Shipments are expected to continue throughout the winter with principal production coming from an important ore deposit immediately adjacent to the mill on the property. Considerable reserves have already been developed at various other locations on the nearly eight miles of contiguous claims which the firm holds. Consequently, mill operations are to be increased.

Huntley Industrial Minerals, Inc. is reactivating its *Blue Star* talc mine near Big Pine, Inyo County, California. The company operates a talc processing plant at Laws in Inyo County. Huntley also has completed a clay processing plant at Hot Creek, Mono County, California. The clay will come from a nearby deposit.

California Limestone Products reports that work at its Langdon manganese property 22 miles northwest of Blythe, California has recently opened a large amount of ore. Workings are now down 80 feet. Ore assaying below 40 percent manganese is sent to the 400-ton-per-day mill of *Blythe Mining Company*, adjacent to the property, which retains 35 percent of the gross as a milling fee. An average of 70 tons per day is reportedly being supplied to the mill. This is expected to double in the near future when Cal Lime gets its newly leased *Arlington Blackjack* property, 10 miles away, into operation. Caving of the glory hole disrupted operations recently. Cal Lime is sinking a shaft through the caved glory hole in order to resume production.

Manganese Inc's new primary conditioner unit at Henderson, Nevada has added 1,000-hp. to the conditioning circuit. With an addition of power in the secondary conditioners, the conditioning rate has been increased to the amount necessary to treat ore from the newly opened Hydro Pit.

The *Anaconda Company's* Yerington plant at Weed Heights, Navada treated about 4,500,000 tons of oxide copper ore with a copper content of 0.83 percent during 1956. During the same period, 7,400,000 tons of waste were removed, and 235,000 tons of sulphur ore mined and trucked from the *Leviathan* mine near the California-Nevada border.

Monarch Mining and Milling Company has awarded a trucking contract to *Wells Cargo* to haul mercury ore to the mill in Goldfield, Nevada. The retort and 100-ton mill are about ready for operation. The Las Vegas firm purchased the mill from the *Newmont Mining Corporation*.

Kennecott Copper Corporation closed down its Kimbley Pit at McGill, Nevada on December 31, 1956 because of depletion of the ore body, although it was the 18th largest copper producer in the United States in 1955. Mining and development of the company's Veteran pit, the newest, is proceeding rapidly. Underground operations are concentrated in the Minnesota Hi ore body which lies above and south of the Deep Ruth ore body. The latter will be mined when the Minnesota Hi has been mined out, possibly by the end of 1957.

Pedlar and Associates are drilling the *Ford Properties* tungsten mine near Mill City, Nevada. Twelve inclined holes are being drilled from tunnel level to intersect veins at the 500-foot level. The group has been given an interest in the property for this work. The nine claims are owned by Phil Forge and his sons-in-law, Ernest Cerini and Frank Wagner. Mr. Wagner has been in charge of the crosscut tunnel operation which cut adits at 300, 150, 110, and 105 feet.

Monarch Milling and Mining Company has purchased a retort for its mercury operation at Goldfield, Nevada. The company purchased the former *Newmont Mining Company* mill, and milling is now expected to be at a rate of 100 tons per day. The ore will go through a flotation process and the concentrate into the furnace.

Natural Resources Development Inc., with headquarters at Shattuc, Illinois, plans to undertake an extensive drilling and development program in the Tonopah mining district. The firm is said to

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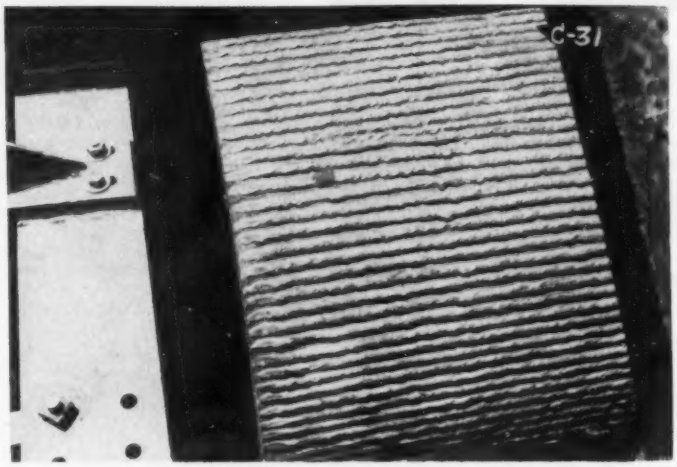

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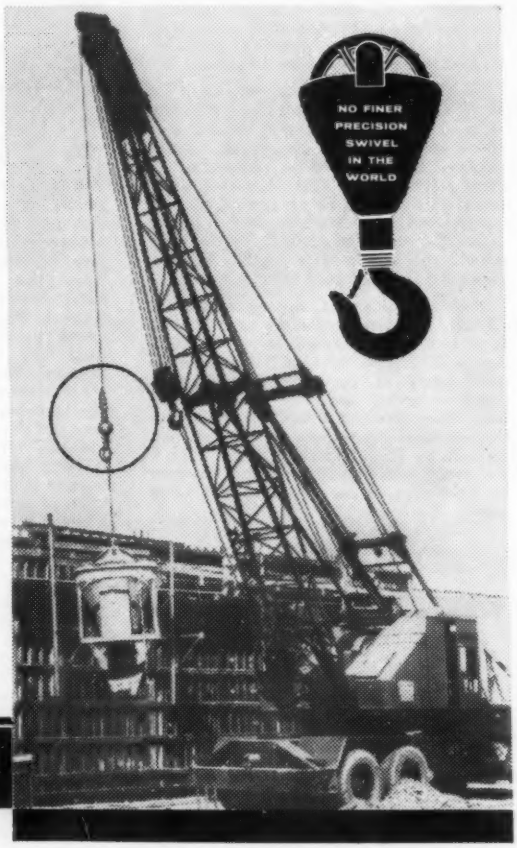

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have already done some preliminary drilling there on uranium-bearing property leased from Byron Foster of Tonopah. The company also plans to exercise its option on 80 claims held by *Tonopah Development and Exploration Company.*

NEW MEXICO

The *Empire Zinc Division* of *New Jersey Zinc Company* is undertaking an increase in operations at its Hanover, New Mexico property. A new 658-foot shaft is in partial use and is expected to be in full production within the next year. Improvements have been made in the mill and some new surface buildings have been erected.

St. Anthony Uranium Corporation, wholly owned subsidiary of *Climax Molybdenum Corporation,* has purchased a 10-month option on land near Grants, New Mexico for $112,500. St. Anthony recently started shaft sinking operations at its property in Valencia County, and there is speculation that this new site may be for a mill.

National Potash Company's $19,000,000 potash mine and mill near Carlsbad, New Mexico are near completion and production should be underway shortly. Two shafts were sunk about 1,700 feet deep and a 21-mile water pipeline was laid. *McKenzie & Whittle* handled the shaft work, while *Stearns-Roger Company* did the surface work. The project is a joint venture of *Freeport Sulphur Company* and *Pittsburgh Consolidation Coal Company.*

The *Chino Mines Division* of *Kennecott Copper Corporation* placed all supervisory personnel on a five-day work week as of January 1. This group had been working a six-day week since 1938. The curtailment will not reduce the production schedule at the operations, say company officials.

The Bureau of Public Roads has AEC approval for a $400,000 road building project to the uranium fields in the Ambrosia Lake area, according to W. J. Keller, district engineer for the Bureau.

An $80,000 mill to recover free gold, metallic copper, iron oxides, and carbonates is being built in the Manzano Mountain foothills east of Isleta Indian Pueblo, south of Albuquerque, New Mexico by *International Uranium Corporation.* The firm will truck its concentrate to the *Phelps Dodge Corporation* plant at Douglas, Arizona.

Florida Manganese, Inc. is constructing a $25,000 roasting plant near its mill southwest of Deming, New Mexico. Carl M. Loeb, Jr. of New York City is president; Vincent M. Ryan is executive vice president; and A. C. Melting is general superintendent. Harry Burgess is engineer and geologist, and Roy L. Hicks is mill superintendent.

Potash mining companies in the Carlsbad district of New Mexico are protesting vigorously the application of *Velma Petroleum Corporation* for permission to drill four wildcat oil wells in the potash area in Eddy county. They claim that such drilling operations would endanger their mines through gas seepage and prevent them from completing operations on levels where they have left pillars.

The *Potash Company of America* is well satisfied with the work of its "Machine and Method for Mining Underground Deposits," for which it obtained a patent last July. Model 100, "PCA Continuous Miner," was designed by PCA engineers to do a job under the unique conditions of potash mining in the Carlsbad district. It weighs 18 tons. Large equipment manufacturers had been approached but showed no interest in making such a machine, so PCA did it for its own mine, and followed up with other similar machines. The machines are recovering ore that might otherwise have been lost, an official of the company said.

The Werner Lake Nickel Mines, Ltd. of Toronto, Canada, is drilling and exploring the copper property it holds in the Lordsburg district of New Mexico. Former owners sunk a shaft to 400 feet and produced some 200,000 tons of ore. Werner Lake Nickel Mines has dewatered this shaft and resumed underground development. Its property includes the *Henry Clay, Atwood, Waldo,* and *Anita* mines.

Efforts to change water rights in the Bluewater district, near Grants, New Mexico, from agricultural to industrial uses, presumably for uranium milling, are being contested by some of the commercial vegetable firms operating in the area. It was for vegetable growing that these

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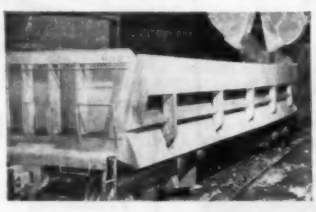

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firms developed underground water sources in the district some years ago.

The Texas City, Texas tin smelter has been sold to *Wah Chang Corporation* for $1,350,000. The company also promised to pay an additional $2,00,000 if it makes a success of operating the smelter. The sale calls for 10 percent down and the remainder payable in annual installments over the next 10 years at 4 percent interest. The government reportedly invested $13,000,000 in the facilities. Wah Chang has announced it intends to produce tin metal, tin alloys, and tungsten, following extensive modifications and redesign of the present facilities.

A recent *Bureau of Mines* report describes preliminary laboratory tests which may lead to increased recovery of iron from ores in east Texas. The test were part of an intensified research campaign to find methods of utilizing limonitic brown iron ores of the state more efficiently. Five samples were taken from mines in Morris, Cass, and Rusk counties, these being considered typical of the ores now being mined. Metallurgists at the Bureau's Rolla Missouri laboratories found tahat roasting, grinding, and magnetic separation recovered more than 80 percent of the iron in concentrates of usable grade. Commercial treatment, employing crushing, washing, and screening, reportedly averages about 50 percent recovery. The area has estimated reserves of approximately 140,000,000 tons of commercial grade ore. The report was prepared by M. M. Fine, D. W. Frommer, and W. M. Dressel, all metallurgists at the Rolla Station, who explain that these preliminary results should not be considered a basis for revising ore-treatment methods at commercial plants. However, they point out, the tests showed there is a substantial quantity of recoverable iron in wastes from these plants. The Bureau plans to conduct further studies on the brown ores and on other iron-bearing material in east Texas now considered too low-grade or too complex to be utilized commercially.

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A shoot of lead-zinc ore has been found in the old *Morning* mine which *American Smelting and Refining Company* has been in the process of closing for several years. Lower workings of the 68-year-old mine at Mullan, Idaho, in Shoshone County's Coeur d'Alene mining district were allowed to fill with water and about 150 men (at one time 700 were on the payroll) have been mining ore pillars in upper workings. The new strike was made in the Noonday vein which parallels the main Morning vein but which never produced much ore. The ore was found after putting in a couple of rounds on the vein from a 1250-level crosscut which had gone through a barren portion of the structure many years ago. J. C. Kieffer of Wallace is general manager of ASARCO's Northwest mining division.

To facilitate a stepped-up mineral exploration program, the *Bunker Hill Company* has purchased a twin-engined, five-place Cessna 310 to ferry geologists to distant points. Steel chutes are being experimented with in the *Bunker Hill* lead-silver mine at Kellogg, Idaho. At the firm's electrolytic zinc plant, several new buildings have been roofed and enclosed to permit winter installation of equipment. They include an anode reconditioning unit, a cell and melting structure, a lead-burner shop, a manganese unit, a purification department, a change house, and an additional generator plant. A fire at the collar of No. 3 shaft recently damaged some timbers and caused a one-day suspension of underground work.

Scheelite tungsten in quartz veins and in quartz stringers widely disseminated in a rhyolite porphyry dike have been discovered in the old Elk Mountain silver-lead district southeast of Beauty Bay on Coeur d'Alene Lake, Kootenai County, Idaho. The find was made in a road cut by Edgar A. Oehrling and Arno W. Mollenhauer of Spokane who were checking for uranium with a black light. They had bulldozed the road to reach a lead-silver showing. *Painted Desert Uranium and Oil Company* of Spokane has leased the 17-claim property.

Production of silver ore has been resumed on a limited basis in the Yankee Girl vein in the property of *Metropolitan Mines Corporation* adjoining the *Sunshine* mine on the south. Output is from an intermediate 3200 level near Metropolitan's western boundary. *Sunshine Mining Company* is the operating firm. Roy K. Kingsbury of Wallace, Idaho is president of Metropolitan.

Nabob Silver-Lead Company is preparing to start drifting and stoping operations off a newly completed development winze at its Pine Creek district property, Shoshone County, Idaho. Development ore mined in sinking the winze 220 feet brought good smelter returns. The new working level will be at the 190-foot point. C. C. Dunkle is vice president and manager.

Mine production has been averaging about 150 tons daily at the *Lucky Friday* mine of *Lucky Friday Silver-Lead Mines Company* east of Mullan, Shoshone County, Idaho. Ore is stockpiled for the Golconda custom concentrator. The main shaft had reached a depth of 2,600 feet at last report and a station had been cut for a new 2450 working level. Exploration also was being carried in in adjoining *Gold Hunter* ground from Lucky Friday workings under a lease agreement with *Day Mines, Inc.* Dave Elder is superintendent.

At the *Crescent* mine east of Kellogg, Idaho, the *Bunker Hill Company* has started development of four silver-copper ore shoots found in 5,000 feet of drifting along the Alhambra fault at a depth of 3,200 feet. Raising is scheduled to the 2400 level. Work is on a two-shift basis. Stanley McDougall is manager of mines.

A vein of silver-copper ore nearly three feet wide has been intersected in the property of *Rainbow Mining and Milling Company* west of Wallace, Idaho. The discovery was made by *Polaris Mining Company* at a depth of 3,000 feet. Drifting was undertaken along the new vein structure to determine extent of the deposit. L. J. Randall, Wallace, is president of Polaris.

Sunshine Mining Company has had encouraging results from recent work in the Rotbart sector of the Chester vein in the Silver Belt between Kellogg and Wallace, Shoshone County, Idaho. Some additional ore reserves have been developed in the Sunshine, Omega and Yankee Girl areas. Exploration of a new footwall vein in the Sunshine area at depths of 3,850 and 4,000 feet disclosed a fairly strong structure with spotty ore content. Robert M. Hardy Jr., Spokane, is president.

Exploration of a thorium-monazite-columbium-tantalum deposit near Warm Springs Creek, Custer County, Idaho is planned by Alfred G. Hoyl of Denver, Colorado and Associates. The Defense Minerals Exploration Administration has approved a $29,986 exploration project, with government participation of $20,240.

Fortune Mining Company and *Eastern Lead Corporation* stockholders have approved a proposed merger with *Northwest Uranium Mines, Inc.* All are Wallace firms. Dr. F. E. Scott is president of Northwest, which has blocked out a good-sized uranium ore body in the Spokane Indian Reservation of Stevens County, Washington.

The *Bunker Hill Company* of Kellogg, Idaho has acquired the *Associated Lead & Zinc Company* of Seattle, formerly jointly owned and operated by the Bunker Hill Company and *Eagle-Picher Company*. Associated Lead now becomes the Chemical Products Division of Bunker Hill and will continue to manufacture a variety of lead and zinc products, principally lead oxides, litharges, and red lead. It will also continue to act as West Coast sales agent for Eagle-Picher's Chemical Division. Roger H. Cutting, formerly president of Associated Lead, recently was elected vice president of Bunker Hill. Bunker Hill's expansion program at the electrolytic zinc plant at Kellogg is right on schedule. Major addition is an expanded generator plant, a new cell and melting room, and a manganese recovery unit. The initial phase of the $7,000,000 project will be producing by mid-1957, and the final phase by July 1958.

Anaconda Company has ordered equipment from the *Westinghouse Electric Corporation* to drive and control the two most powerful hoists ever installed in this country. The hoists will be used at the 4,720-foot-deep Ryan shaft to be sunk soon in Butte, Montana. The hoists will be capable of elevating copper and zinc ores at the rate of 36,000 pounds a minute. The $1,000,000 order for Westinghouse includes motors, motor-generator sets, and speed control equipment to pull each skip with a 36,000-pound load up the shaft at better than 30 miles per hour. The hoists will operate from four levels, the shallowest 1,636 feet, and the deepest 4,720 feet below the shaft collar.

The *Molybdenum Corporation of America* has optioned property in the Bluenose mining district of Ravalli County, Montana, and extending into Lemhi County, Idaho. The claims are the *Violet Nos. 1, 2, 7 and 8* in Montana, and *Nos. 3, 4, 5 and 6* in Idaho. Owners are N. Dean, Mary Motley, and Bert Smith of Darby.

A limited production schedule will be undertaken in the spring at the *Third Term* mine near Elliston, Powell County, Montana by *North Western Mining & Exploration Company* of Seattle. A recent trial shipment of concentrates showed good values in gold, silver, lead and copper. Exploration work also is planned at the property held under lease and option.

Well satisfied with 1956 stripping and diamond drilling at the *Moose Hill Mining Company* property near Libby, Montana, officials are planning an underground exploration program in the spring. Good tungsten values were obtained from a five-foot vein opened by cuts along a strike length of 1,200 feet. The company is applying for a $75,000 DMEA loan. Kenneth B. Morlan of Spokane, Washington is president.

Sunshine Mining Company has abandoned an investigation-exploration project at the old *Cracker Creek* gold camp northwest of Baker, Oregon.

Lakeview Mining Company is reported to have sunk its 300-foot shaft about one-third of the total distance so far. The company is developing the *White King* uranium property near Lakeview, Oregon. The firm is an affiliate of the *Thornburg Brothers* of Gunnison, Colorado.

A high purity limestone deposit at the head of Marble Creek, Baker County, Oregon is being readied for production by the *Chemical Lime Company of Oregon*. Quarry benching and plant construction are under way. The quarry operations will consist of complete primary and secondary crushing with complete screening for various sizes of limestone. The

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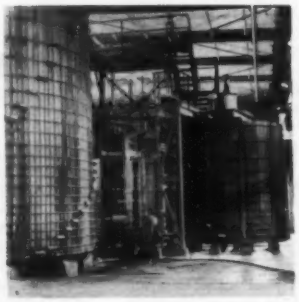

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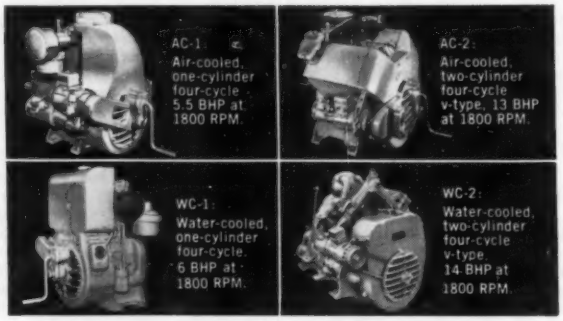

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AMERICAN MARC also manufactures Diesel generating plants from 3 to 10 KW (AC or DC, and industrial three-phase), Diesel pumping units from 4 to 1700 GPM, marine propulsion, refrigeration units and power-packages for other services. American MARC can adapt any of its Big 4 engines to fit every job requiring from 5 to 20 BHP.

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rail side plant will consist of stockpiling facilities for raw limestone, with two rotary kilns for calcining. A complete line of raw limestone, quicklime, processed and hydrated lime, will be produced. Production is scheduled for early in 1957. Owners are Mr. and Mrs. Anthony Brandenthaler. Robert G. Vervaeke is general manager, and Stoyanov and Johnson of Portland, Oregon, are design engineers.

WASHINGTON

Daybreak Uranium, Inc. has been negotiating for possible construction of an upgrading mill and investigating a mechanical upgrader to treat low-grade material at its Spokane area properties. Meanwhile, it has resumed open-pit mining and stockpiling of autunite ore at its *No. 1* mine in the Mount Spokane district. Stripping was started at the sight of a new ore discovery 150 feet west of current mining operations, where a drill hole indicated commercial grade autunite from the 35-foot depth to the 50-foot point. James W. Fox of Opportunity, Washington, is president and Kae Sowers, secretary-treasurer.

Dahl Uranium Mine, Inc., at last report, was preparing to start shipments from the Mount Spokane district. Production was from two autunite-bearing zones uncovered by bulldozing at a depth of about eight feet. Ore in an eight-foot iron-stained shear zone and in a two-foot kaolin clay seam was so high grade at the point of discovery that pick-and-shovel mining was started. The mine access road was regraded with the object of carrying on operations throughout the winter. It was planned to ship to the Salt Lake processing plant of Vitro Uranium Corporation. H. J. Tibbits of Spokane is president.

A rotary drill rig has been moved onto the property of *Northwest Uranium Mines* in the Spokane Indian Reservation, southwestern Stevens County, Washington to provide ore cores for mill testing. Additional exploratory drilling also was planned to determine if a second "basin" deposit of uranium exists west of a fault which cut off a deposit estimated to contain about 500,000 tons. The firm is planning an upgrading mill to treat that portion of reserves which will not meet the 0.20 percent uranium oxide minimum for ores to be purchased by the $3,000,000 uranium processing plant under construction by *Dawn Mining Company* just outside the Reservation at Ford. Dr. F. E. Scott, Wallace, Idaho, is president.

The old *Mineral Hill* mine two miles west of Conconully, Salmon River mining district, Okanogan County, Washington is being reopened by *Sunny Peak Mining Company* of Spokane. The 1,050-foot main working tunnel of the early day silver-copper-gold-lead producer has been retimbered for about 500 feet. Future plans will be made following inspection of the white quartz veins in porphoritic syenite. John Cross of Lodi, California and Lawrence Fuller of Paradise, California are supervising work.

Milling grade copper ore has been found in two long-abandoned, hand-driven tunnels in the Deer Trail mining district of southwestern Stevens County, Washington. *Viking Excavator Company* of Spokane made the discovery while looking for uranium on 31 claims staked by the firm east of the old *Turk* copper camp. A 1½-mile access road then was built along an old pack trail. Viking is owned by Ernest and Walter Johnson and William Keimig.

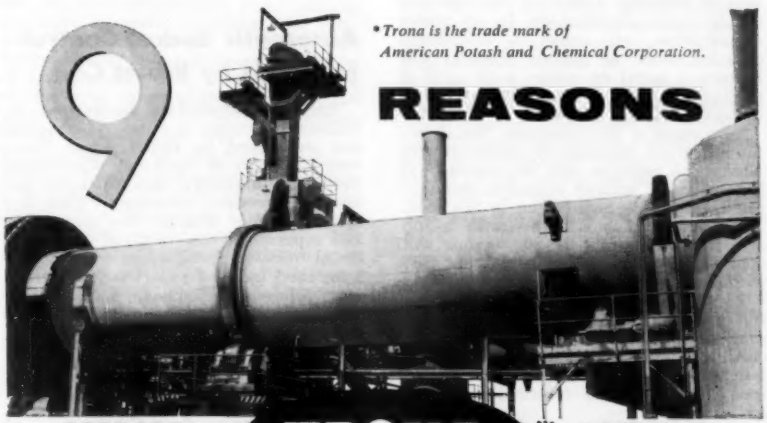
Mine Consultants, Inc., Spokane, has been carrying on an intensive soil sampling program at 52 claims it staked in the Russian Creek area near the juncture of Stevens and Pend Oreille counties (Washington) and the British Columbia border. The claims are adjacent to the old *Frisco Standard* lead-silver mine and holdings of *Day Mines, Inc.* of Wallace, Idaho. Richard Weaver is vice president.

Drill hole probing has indicated commercial autunite at a depth of about 80 feet at holdings of *Mars Production Corporation* in Pend Oreille County's Lamb Creek district, Washington. The drilling followed bulldozing of two surface anomalies. The showing is in decomposed granite. A preliminary survey has been made of a 2,100-acre permit area in the Spokane Indian Reservation, Stevens County. Carl C. Schreiner is general manager.

Low-grade coal containing uraninite, gummite, and autunite has been found by *Big Smoke Uranium, Inc.* 600 feet northwesterly from its open-pit discovery operation in the Spokane Indian Reservation, Stevens County, Washington. Previous exploration had failed to find the anticipated extension along the indicated strike. An airborne scintillator picked up a faint anomaly where none had been noted by ground equipment. The Spokane firm was successful bidder for two adjacent tracts offered for lease by the Bureau of Indian Affairs. William O. Kumbera is president.

North Western Mining & Exploration Company of Seattle, Washington has acquired an additional 25 percent interest in the *Saber* and *Fat Fraction* claims in Snohomish County's Sultan Basin, giving it 100 percent ownership. At last report, core drilling was underway.

Unwatering of old winzes and reopening of at least two old tunnels is planned along with diamond drilling on Rickert Mountain, near Blue Creek, Stevens County, Washington by *Guaranty Mining and Development Company* of Spokane. Company holdings include early-day locations by *Krug Gold and Copper Mining Company*. Work during the past season included bulldozing of access roads, geophysical surveying, and a Geiger counter check. William B. Mills is president and Joe L. Stillwell, secretary.



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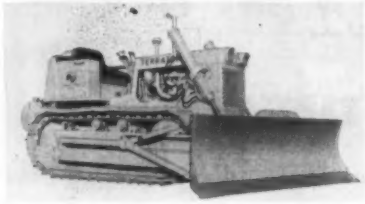
Sharples Develops New Dry Powder Classifier

The Sharples Corporation has developed a new classifier, for dry classification of particles, based on the principle of air vortex classification. In air vortex classification, air enters a centrifugal chamber from the outside diameter and follows a spiral or vortex path until it is discharged through an opening nearer the center of the chamber.

According to the company, this classifier effectively increases the precision with which fine particles may be classified at high capacity without regard to throughput rate or size distribution in the feed. For example, fine fractions with a top size in the range of 15-20 microns will contain less than 0.01-0.04 percent 325 mesh screen residue.

Extremely small and compact, the five ton per hour model occupies about the same space as an office desk, providing exceedingly high product recovery, regardless of feed rate or size distribution of feed. For additional information please circle No. 76.



Advance Design Features On Case-Terratrac Models

According to the manufacturer, three new engineering advancements, now standard on the Models 800 and 1000 Case-Terratrac Crawlers, could easily change the entire concept of crawler tractor design and performance.

The new features include complete independent power control of each track, both as to speed and direction; torsion bar track suspension, providing for each track to move as much as 12" up or down, without disturbing the level operation of dozer blade or loading bucket; and two-point centralized lubrication system for the lower track wheels.

The new machines have four forward speeds up to 6 MPH, and four reverse speeds up to 7 MPH. With the power control on each track, it is possible to turn the machine in its own length during operations in restricted areas.

The suspension system for the tracks, the manufacturer says, enables the machine to operate at top efficiency over rough ground, relieving considerable strain on the track frame. This design enables the tractor to deliver full power and traction on both tracks when working rough terrain.

The two machines are available with 1¼ and 2 cubic yard loaders, an angling dozer blade that operates hydraulically from the operators seat, a straight hydraulically powered bulldozer blade the tips fore and aft, tilting for ditching, and other tools for use with the machines.

Circle No. 68 for further information.

Automatic Bucket Control Featured by Riblet Co.

Automatic control of buckets at the unloading terminal is a new development just announced by Riblet Aerial Tramway Company of Spokane, Washington, designers, engineers, manufacturers and erectors of aerial tramways. This new feature greatly reduces the man-power and supervision now required in conventional tramway installations while, at the same time, increasing efficiency. For tramway information consult Riblet Aerial Tramway; see their advertisement in this issue. Circle No. 80.

Union Miniere Orders 14 Giant Macks for Congo

Mack Trucks, Inc., recently reported receipt of an order for 14 more LV off-highway units for Union Miniere Du Haut Katanga, of Elisabethville, Belgian Congo, for use in the Belgian Congo. They will be used to haul copper ore from Union Miniere's giant open pit copper mine at Kolwezi, bringing to 37 the number of big Mack dumpers purchased for the operation.

The LV's, capable of carrying 22½-ton loads, are powered with 275 hp Diesel engines, and Mack transmissions with torque converters. The bodies are equipped with special heating systems, using the engine exhaust, to allow free flow of the ore when dumping.

Lightweight Core Drill Available to Prospector

The Monarch Diamond Core Drill, manufactured by the Monarch Equipment Co., in North Hollywood, was designed for the prospector. It is easy to operate, requiring one or two men, and drills to approximately 200 feet. Parts are all standard, and are easily replaced.

It is being used now, not only for uranium testing, but for gold, copper and tungsten. It is also used for foundation, water and soil testing.

The Monarch Drill is strong and durable yet easily transported. It is readily mounted on a Jeep, trailer, or can be skid mounted. It weighs 500 pounds, and can be dismantled into four units. It drills a 1 3/16-inch hole, and takes a ¾-inch core. For further information circle No. 73.

Euclid Builds New 40-Ton Rear Dump Truck

A new 40-ton Rear Dump Euclid with a struck capacity of 26 cubic yards is announced by the Euclid Division of General Motors Corporation. A twin-Power unit with separate engines, each driving its own rear axle through 3-speed Allison Torqmatic Drives, the new unit replaces Euclid's former 34-ton model.

Known as the R-40, it is powered by either two 235 hp G.M. engines or two 250 hp Cummins engines. Both are turbocharged providing a substantial increase in horsepower. Tires have been increased in size to 18.00 by 25 and a larger differential employed. The R-40 will be displayed at the forthcoming road show in Chicago this January. Circle No. 77 for further information.

Hewitt-Robins Executive Returns from World Trip

H. Von Thaden, vice president of Hewitt-Robins, Inc., recently returned to the United States after spending about eight months in Africa, Italy, Holland, Germany, Belgium, France, and England.

In conjunction with his trip, Mr. Von Thaden visited mining operation in the various countries, as well as Hewitt-Robins subsidiaries and affiliated companies.

Hewitt-Robins manufactures machinery and industrial rubber products for mining companies throughout the world.

BIT AND ROD SHOP EQUIPMENT: Ingersoll-Rand Company has available for you a copy of a brochure describing their complete line of equipment for economical bit and steel reconditioning. Circle No. 1 for your copy of this useful brochure.

AMPCO CENTRIFUGAL PUMPS is the title of a new booklet published by Ampco Metal, Inc. describing the complete line of Ampco pumps. The high-speed centrifugal pumps are designed to handle clear liquids and fine slurries. They have "correct-design" closed impellers for greater efficiency and longer life; wear rings to save casing, and many other features. Circle No. 2 for your copy.

DUST RESPIRATOR: The U.S. Bureau of Mines has issued an approval number to a new respirator for protection against dusts, Pneumoconiosis Producing Mists, and chromic acid mist. The new respirator, introduced by Willson Products Division; Ray-O-Vac Company, is called the No. 600 Monomask. For further information on this integrally molded rubber respirator circle No. 3.

MINE BATTERY BULLETIN: C & D Batteries, Inc. have just released their specification bulletin ML-567/56 covering their complete line of Slyver-Clad batteries for mine locomotives, trammers, shuttle cars, and tunnel haulage equipment. Data is included on battery ratings, capacities, details of design and construction, dimensions, and weights. Circle No. 4 for your free copy.

SHAFT JUMBO: Ingersoll-Rand announces a new advance in shaft-drilling equipment—the Hydra-Boom Shaft Jumbo. According to the company the new unit will save set-up time, drilling time and manpower. Company engineers can tailor the unit for your sinking needs. Some of the machine's features are: better control of hole pattern and direction, better fragmentation, faster drilling with the larger size drills used, built-in safety factor with the metal overhead canopy offering protection against falling objects. Circle No. 5 for additional information.

BOX POINTS AND ADAPTERS manufactured by Electric Steel Foundry Company are described in a new booklet released by the company. Esco Box Points and Adapters for dippers or buckets, are made of special cast alloy steel, differentially hardened for abrasion resistance and shock-absorbing toughness. Six box point designs are described. Circle No. 6 for your copy.

WELDING SPEED DOUBLED with the semi-automatic hardfacing method developed by the Stoody Company. According to the company the method has the following advantages; deposition rates as high as 20 pounds per hour, open arc welding with no flux, complete visibility of the arc, no stub end losses, no time wasted in electrode changing, hardfacing and build-up wires for every purpose. For further information on semi-automatic welding circle No. 7.

ALUMINUM PIPE COUPLERS: The John Bean Division of Food Machinery and Chemical Corporation has recently released an interesting and informative brochure on their line of aluminum pipe couplers for aluminum pipe. Savings in labtor, weight, and time may be realized by using lightweight aluminum pipe and couplers. The couplers are capable of handling pressures of up to 1000 psi, and are designed to eliminate leakage. Circle No. 8 for your copy.

PREVENTIVE MAINTENANCE with Molub-Alloy Gear Oils and greases is saving many operators much down time, and lowering costs of operation of heavy mining and excavating equipment. Basically a metallic type lubricant, Molub-Alloy's outstanding lubrication characteristics especially under extremes of temperature and adverse conditions should be investigated by you. Circle No. 13 for further information.

HELICOPTER SERVICE: Rick Helicopters, Inc. have available for you a recently published brochure describing their complete helicopter service both here and abroad. Look into this low-cost method of transportation into hard-to-get areas; of this rapid means of detailed aerial and geophysical surveying and prospecting. Circle No. 16 for your copy.

NEW TYPE PULVERISER: Foster Wheeler Corporation announces the Type MB planetary roll and table pulverizers, developed in Germany, in a new four-page brochure now available to you. The new pulverizer, offering unusual advantages in economy of operation and maintenance and in uniformity of product fineness, is being made in 10 models with capacities of from two to 40 tons per hour. Circle No. 20 for your copy.

SAFETY EQUIPMENT CATALOG: A comprehensive safety catalog illustrating and describing hundreds of products you can use in your mining operations is available from Mine Safety Appliances Co. Safety Engineers particularly will want a copy of this catalog for ready reference. Circle No. 21.

EXPLOSIVE USERS will want a copy of the revised and up-to-date list of "Do's and Don'ts" for handling explosives which is available from the Atlas Powder Co. It contains vital precautions to observe when shooting either electrically or with cap and fuse, eleven suggestions for minimizing poison gas hazards, suggestions on the prevention of misfires, and approved methods for priming. Circle No. 22 for your copy.

DUST PROBLEMS? Mine and mill operators troubled with dust problems and loss of valuable fines will be interested in the Johnson-March Type A Hydro Precipitator Scrubber. Collection of all types of dust, including sub-micron particles, and recovery of valuable materials are handled efficiently and economically. A recent bulletin, describing the Type A Scrubber, is available to interested readers. Circle No. 23.

YIELDABLE ARCH SUPPORTS: Bethlehem Steel's yieldable steel arch supports are made of rolled nestable sections, clamped together at the ends to make a joint which yields under pressure. As the load on the arch increases, the joints continue to yield, thus relieving the load and at the same time maintaining the structural integrity of the arch. They are easy to install without special tools or skills, require a minimum of maintenance and have a high recovery value. For more information circle No. 24

BIT AND STEEL CATALOG: Brunner & Lay, Inc. has a new 20-page catalog which contains illustrations and complete specifications for carbide rock-bits, drill steels and pneumatic tool accessories. Included in the catalog are suggestions for obtaining the best service from carbide bits. You will want a copy of this informative catalog, so circle No. 25.

AIR & WATER HOSE users will want a copy of a condensed catalog available from the Le-Hi Division of Hose Accessories Co. It illustrates and describes hose couplings, clamps, valves and manifolds, hose nipples and hydraulic hose assemblies. Circle No. 34.

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LARGE DIAMETER HOLES: Spang fabricated star bits replace the conventional, old-style spudding bit and the big hole paddle-type bit for churn drilling. Made in large diameters for drilling hard formations by Spang & Co., the fabricated star bits can be dressed, ready for drilling, by hard surfacing quickly and economically. For detailed information, circle No. 35.

MILL OPERATORS will want a copy of Syntron Co.'s complete catalog covering vibrating screens, vibratory feeders, electric vibrators, test sieve shakers, and many other items. For your copy circle No. 36.

CHOOSE THE RIGHT MATRIX: Diamond drill bits are available from Anton Smit & Co., Inc. with a choice of three matrix hardnesses. The special tungsten alloy powdered metal matrix is designed to fit your special drilling conditions. A catalog is available describing the complete line. Circle No. 37.

DRILL BIT CATALOG: A new catalog recently published by Herb J. Hawthorne, Inc. illustrates and describes all the types of bits produced by this company. In addition the catalog contains considerable information on the subject of "Engineering a Hole in the Ground" which discusses in some detail the problems involved in drilling, including types of ground, shot-hole drilling, etc. Circle No. 38 for your copy.

PROSPECTING FOR URANIUM? Electro-Technical Labs, have recently developed a new instrument for you which produces a permanent record of radioactivity in shot holes, core holes, or surface outcrops. The RL-1 includes a radioactivity counter, graphic recorder, cable and chart drive, 250 feet of cable, and a rugged, highly sensitive hole probe. Power many be derived from an "A" battery or an automoble cigar lighter. Circle No. 39 for more information.

SHEAVE BLOCKS: Joy Manufacturing Company has available for you a free bulletin number 46-8, featuring their line of quick opening sheave blocks with a non-removable locking pin. The pin cannot loosen and fall out when locked in place. Other features include sealed lubrication, chrome nickel molybdenum heat-treated sheave wheel, and other excellent features. Circle No. 40 for your copy.

GYRATORY CRUSHERS: The Traylor Engineering and Manufacturing Company have recently published a bulletin on Traylor Gyratory Crushers. Suitable for both primary and secondary crushing, Traylor crushers are presently finding extensive use with the super-hard Taconite ores of the iron ranges. Circle No. 41 for your copy.

LOW COST mechanical and metallurgical performance may be realized with the Akins spiral type classifier. The Colorado Iron Works Company has published how and why this is possible, in their new Catalog 55C on the Akins classifier. Circle No. 42 for your free copy.

MAGNETIC SEPARATORS: The Jeffrey Manufacturing Company has published a new booklet on their drum type magnetic separators. Complete information is contained on operation and use of the separators for wet separation and magnetic recovery problems. Circle No. 43 for your copy.

UDDIA DRILL STEEL: An interesting booklet on the correct care and use of the Uddia tungsten carbide tipped integral drill steel is now available to you from the Uddeholm Steel Co. This Swedish manufacturer of drill steel, with carbide tipped points, gives you the benefit of its long experience with drill steel in this informative booklet. Circle No. 44 for your copy.

NEW EARTHMOVING EQUIPMENT: Clark Equipment Company's Construction Machinery Division announced today that it will soon start producing new types of road building and earthmoving equipment. Clark's new equipment will include a line of Tractor Scrapers, Tractor Dozers, plus major additions to the present line of "Michigan" Tractor Shovels. Circle No. 28 for further information.

MOTOR SELECTOR: A new 12-page Reliance Motor Selector, published by Reliance Electric and Engineering Company, gives full information on how to select a-c motors for specific applications. Included in the new booklet are selection data on speed-frequency relationship, NEMA design classes, torque characteristics, frame selection tables, and other useful information. Circle No. 29 for your copy.

STAINLESS STEEL SCREENS: The use of stainless steel screens in heavy-duty separating and conveying equipment is covered in a new 28-page book published by the Bixby-Zimmer Engineering Co. The book illustrates the various screen shapes that can be created for specific installations. Circle No. 17 for your copy.

BELTING CATALOG: Complete data on conveyor, elevator, and transmission belting, is included in the new Boston Woven Hose & Rubber Belting Company catalog. Reference tables and specification information provide a working guide for engineers and purchasing agents. Circle No. 18 for a copy.

WET & DRY GRINDING MILLS: Hardinge Company, Inc. has just issued a 6-page brochure, covering its major types of reduction mills for both wet and dry grinding, and pulverizing. Described are Tricone, Rod, Cylindrical, Tube, Batch, Conical, Disc-Roll Mills, accessories, and classifying devices. Circle No. 19 for your copy.

BAUXITE TRAILER: An entirely new trailer, specifically designed for transporting light weight, adhesive materials such as bauxite ore, is announced by Athey Products Corporation. The new 35 ton capacity rear-dump trailer was developed to solve the problem of sticky bauxite ore adhering to vertical and near vertical surfaces of ordinary hauler bodies. Circle No. 9 for further information.

NEW CRANE-EXCAVATOR: The Schield Bantam Company has released a new bulletin giving detailed information on specifications, features, capacities, and applications, of their new crawler-mounted 3/8-cubic yard, 5-ton crane-excavator. Features such as two-speed independent travel, no-shift forward-reverse travel and low ground bearing pressures are fully illustrated and described. Circle No. 10 for your copy.

SOUND POWERED TELEPHONES: The United States Instrument Corporation has available for you a brochure covering their line of sound powered products. Sound powered telephones are unique in that the voice of the person using them supplies all the power needed to operate the system. Circle No. 11 for your copy.

HI-CAPACITY V-BELT: Designed for applications where increased power transmission is desired with a minimum of maintenance on multi-V-belt installations, the Thermoid Company has introduced a new Powerflex Hi-Capacity V-belt. The new belt is available in all standard sizes and features a special oil resistant cover to prolong belt life. Circle No. 12 for detailed information.

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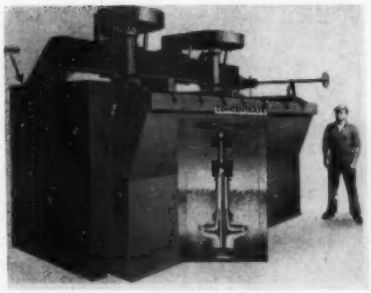


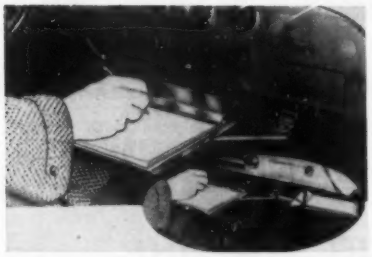
Flotation in the Denver Type "M" Flotation Unit

The Denver Equipment Company now has available for commercial use their new Denver Type "M" Flotation Machine, designed to give most effective metallurgy in high tonnage roughing and scavenging operations. The Denver Type "M" was developed after observations under operating conditions of other major types of flotation equipment. The unit has been tested in the field for several years and according to the company substantially handles more tonnage in less space and reduces tailings losses.

Three principles of aeration are employed to improve flotation conditions:

1. Mechanically entrained air which is
2. Dissolved under pressure to promote nascent air
3. High velocity agitation.

Circle No. 69 for further information on this improved flotation unit.



New Travel Desk Enables Writing in Car or Truck

The General Industrial Co., 5742 Elston Ave., Chicago, has available a Travel Desk, easily installed on the dashboard of any car, which will enable you to write, hold maps, papers or records in the car. A heavy spring clip holds securely a note pad or other papers. The 6¾-inch by 10-inch metal clip board can be located next to the driver, and swings underneath the dashboard when not in use. This handy item can be installed or removed in a matter of minutes, without drilling. Price $3.75. Circle No. 63 for further information, or write direct.

Gelatin Core Improves NH_4NO_3 Blasting Agent

Atlas Powder Company announces a new type of stripping and quarrying explosive which is said to combine the power and efficiency of fixed high explosives with the economy of low-order blasting agents. Called Amocore, the new explosive consists of a basic cartridge charge of Amocol, Atlas' ammonium nitrate blasting agent, with a gelatin core.

The gelatin core, which runs throughout the length of the cartridge, appears to promote the development of full ingredient strength, providing a much more efficient explosive. Amocore must be detonated with a high explosive primer, however unlike conventional blasting agents, the continuous gelatin initiator insures complete detonation, eliminates the need for intermediate high explosive booster charges placed at regular intervals throughout the explosives column in order to maintain detonation. Circle No. 72 for more complete information.

New Underground Mining Tractor Skid-Shovel

International Harvester Company has just introduced a new TD-9 crawler tractor Skid-Shovel designed and equipped for underground mining operations. The new 71 hp Diesel crawler features an exhaust gas scrubber and cooler, and an exhaust gas diffuser operating with the regular blower-type fan and a 40-gallon water reserve tank.

The complete scrubbing system, designed by the Drott Manufacturing Co., is so short-coupled and compact that the length of the regular tractor remains the same. The system's compactness also has permitted International and Drott Engineers to lower the tractor height to six feet, permitting safe transport on rails under low trolley wires. Circle No. 71 for further information.

Porto-Power Equipment Ideal For Rescue Work

A complete line of hydraulically operated rescue equipment for use in releasing victims trapped under wreckage of debris is now offered by Blackhawk Mfg. Co. The highly compact equipment, identified as Porto-Power Rescue Equipment, is designed to carry out an almost unlimited variety of rescue operation. The equipment comes in kits which include a hand-operated pump and a ram, which are joined by a flexible hose to permit remote control of the ram. The kits also contain selected attachments which thread onto the ram to harness it for lifting, pushing, pulling, spreading, clamping, and pressing. Hundreds of rescue combinations are possible. Kits are offered in four, 10, and 20-ton power packages. Send for free brochure, circle No. 70.

Notes From The Manufacturers

Carl G. Schilbe is the new district manager of the Salt Lake City territory in charge of sales for both Industrial and Mining division products of the Jeffrey Manufacturing Company. The Salt Lake office is one of 21 district offices maintained by Jeffrey in principal cities in the United States. The company manufactures mining, conveying and processing equipment, power transmission machinery, and is engaged in contract manufacturing.

E. G. Muir, sales manager for the Omaha Sales Division of Bemis Bro. Bag Company, has been named to head a newly designated sales development section of the company's general sales department in St. Louis. Mr. Muir joined the Bemis organization in 1949 as a salesman at Omaha and was made an administrative assistant there in 1951. He became sales manager in 1953.

Armco International Corporation of Middletown, Ohio and August Thyssen-Huette A. G. of Duisburg-Hamborn, Germany will form a joint steel fabricating company with headquarters at Dinslaken, in the Ruhr Valley. Initial investment will amount to more than $500,000, and the venture marks the first time that an American steel corporation has invested capital in the German steel industry.

Grover Judy, vice president and assistant to the president of Hycon Mfg. Company, will become vice president and general manager of Hycon Aerial Surveys, Inc. He succeeds Duane O. Wood, who recently resigned but will remain as a consultant for the surveying company. Mr. Judy is one of the original founders of Hycon and has recently been in the Washington, D.C. office in charge of over-all planning.

Richard G. Schaal has been named manager of the mine hoist department of the mine, crusher and process machinery division of Nordberg Manufacturing Company. He succeeds the late Ted C. Wiedenhoefer. Prior to joining Nordberg, Mr. Schaal was employed by Cleveland-Cliffs Iron Company for nine years.

The Babcock & Wilcox Company has become the first firm in the United States to obtain general licenses from the Atomic Energy Commission to receive and use special nuclear and nuclear source materials. Each license covers a five-year period ending in August, 1961 and applies to fuel element production operations in B&W's Nuclear Facilities Plant in Lynchburg, Virginia.

Russell W. Knode is the new general manager of sales, Mining Division, of the Jeffrey Manufacturing Company, Columbus, Ohio. Previously he was manager of the field offices, mining division, and has been with the company for 21 years. He succeeds A. R. Anderson who retired in December after 35 years with Jeffrey.

The LeRoi Division of the Westinghouse Air Brake Company has started a five-year $5,500,000 engineering and research expansion program at the company's Milwaukee Plant.

Lima Type 2400 Shovel, equipped with 67-ft. boom, 50-ft. dipper handle, and 4-cu yd bucket, stripping coal near New Bethlehem, Pa.

Lima Type 1201 Dragline, with 100-ft. boom, stripping iron ore at Russellville, Ala.

Lima Type 34 Paymaster Shovel loading coal near Denver, Colo

LIMAS ARE BUILT FROM THE GROUND UP
for high-output stripping and loading

The toughest mantle rock can't stop Limas . . . they strip away overburden with ease, get coal and ore loaded fast. Take a look at some of the features that make the Lima Type 2400 (shown at left above) a favorite:

CRAWLERS are wide and long for greater stability and are steered through air-controlled jaw clutches for ease of handling in close quarters.

TREAD ROLLERS have especially hardened rims to resist wear . . . have piston-ring-type dirt seals and retainers.

MAIN MACHINERY is located so as to hold counterweight to a minimum and to allow faster swing.

DRUMS are mounted in tandem, making it possible to use extra-wide drums . . . a big advantage when operating as a dragline, crane or high-lift shovel, because of the greater cable capacity and longer cable life.

ANTI-FRICTION BEARINGS in the drums hold the brake and clutch surfaces permanently concentric with the center of the shafts, giving smooth, velvety action when they are engaged.

EXTRA-LARGE AIR-CONTROLLED CLUTCHES respond immediately to the slightest movement of the controls.

TORQUE CONVERTER gives greater output, reduces shock loading, prevents engine stall . . cushioned effect of drive lengthens cable life, reduces machinery maintenance.

PRECISION AIR CONTROL lessens operator fatigue, gives constant feel of the work, means more output with less effort.

Get the full story on the Type 2400 and other profit-making Limas from your nearby Lima distributor, or write Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

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Aerial Tram Scheduled For Philippine Operation

An aerial tramway will be installed by Lepanto Consolidated Mining Company on its property in northern Luzon, Philippine Islands, to transport de-slimed mill tailing back to the mine for use in back-filling stopes. Designed by Riblet Aerial Tramway Company of Spokane, Washington, the installation will include automatic bucket control at the upper terminal where the mill tailing will be introduced to the underground workings.

The tram line will span a distance of 4,800 feet horizontally with a rise of 750 feet from the mill terminal to the upper end and will be capable of handling 100 tons per hour. A total of 33, one-ton buckets will carry the tailing back to the mine at 550 feet per minute. Drive for the tramway will be furnished by a 200-horsepower motor. Seven towers will be required to support the span.

When construction is completed, sand tailing from the mill will be introduced to settling basins and de-watered to 12 percent moisture. The de-watered tailing will then be belt-fed to Riblet buckets. At the upper terminal, the tailing will be unleaded into a concrete-lined trench with a conveyor at the bottom. Tailing withdrawn from the concrete trench will be re-pulped and delivered through a rubber-lined pipe and surface bore-hole to the underground workings. The extremely steep and rugged terrain makes tramway haulage of back-fill advantageous over the present method of returning tailing to the mine by truck. In addition, slimes are removed from mill tailing providing a clear discharge of waste water from mill.

Yugoslavia Gets Russian Aid for Al Production

Yugoslavian aluminum production will be expanded as a result of a joint agreement signed by the Soviet Union, East Germany, and Yugoslavia. Financial and technical help will be provided by Russia and East Germany to develop Yugoslavian's rich deposits of bauxite, second only to France. Their initial contribution is a loan of $175,000,000, at two percent interest, to be used for a new 50,000-ton capacity plant and for modernization of an existing plant at Kidricevo doubling its yearly capacity.

Site of the new plant will be Titograd, in Montenegro. Building will start in 1957 and production is scheduled to begin in 1962. Yugoslavia will repay loan by sending aluminum and aluminum products to Soviet Union and East Germany.

Construction is also going ahead on a rolling mill at Razine near Sibenik, in Dalmatia, which will have an annual capacity of 15,000 tons of rolled aluminum products and 4,500 tons of electrolytic aluminum. Another mill is underway at Slovenska Bistrica, in Slovenia, with an annual capacity of 10,000 tons rolled aluminum and aluminum alloys.

West Germany is also making negotitations to lend Yugoslavia $175,000,000 for a 50,000-ton-capacity plant to be built at Mostar in Herzegovina, or in Dalmatia. Representatives of Pechiney, the French industrial group, have also been in Yugoslavia recently to discuss proposed participation in Yugoslavia's aluminum industry.

In 1955, 11,499 tons of aluminum were produced in Yugoslavia. In 1954, the output was 3,496 tons, in 1939, 1,795 tons.

Egypt Seeks Expansion In Mineral Development

The Egyptian Government is embarking on a long-range policy to encourage prospecting and development of the country's mineral resources. The two-part program consists of a new, relaxed set of mining regulations, and a plan for technical assistance to prospectors and miners.

A new Mining Law, enacted in March 1956, promises unconditional rights for exploration. Development rights are also insured if sufficent ore is found to warrant development. All minerals extracted, except petroleum, are free from royalties and other fees and rentals have been reduced. The procedure for obtaining a prospecting license or mining lease has been greatly simplified.

Technical assistance is also being stepped up by the Egyptian Government. Plans are underway for an aerial photographic survey of important sections in Sinai and the eastern Desert bordering the Red Sea coast, from which topographic and geologic maps will be made. A composite magnetic, electromagnetic, and radiation detector aerosurvey for radioactive ores will also be sponsored by the government. A survey of the most mineralized part of the country, the area south of Kosseir in the eastern Desert, has already begun.

Two government mining centers have been established, one by the National Research Council in Giza, Cairo, and the other in Mersa Alam on the Red Sea coast. Research is underway to find the most productive and economic methods of mining and concentrating.

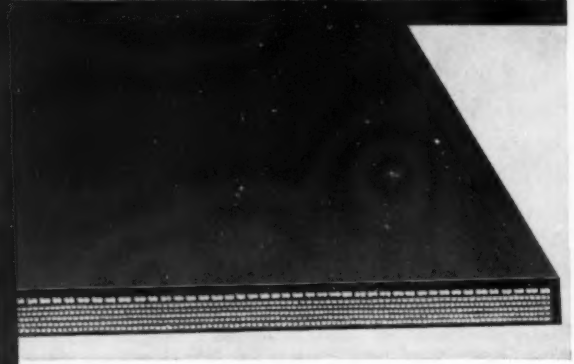
Blast Starts Toquepala Copper Stripping

Stripping at Southern Peru Copper Corporation's Toquepala project in Peru was officially underway in October when more than a million tons of rock was blasted by 270,000 pounds of dynamite. The photograph above shows the principal mountain where 127,000,000 tons of overburden will be removed in the next few years to uncover the copper ore body. The mining camp can be seen in the lower right foreground. Mining of the estimated 1,000,000,000 tons of 1.0 percent copper ore will be started by 1960. According to the American Smelting and Refining Company (largest stockholder), the October blast was the largest mining blast ever discharged. These are the statistics: feet of hole blasted, 51,589; number of holes (churn or rotary) 700; pounds dynamite, 270,000; tons broken, 1,067,000. The previous largest mining blast recorded was that of Algoma Ore Properties, Ltd. at its Helen mine in Jamestown, Ontario, Canada. Here 154,893 feet of hole were blasted comprising 2,437 long holes underground, and only 47 churn holes. 172,500 pounds of dynamite were loaded in the long holes and 133,500 pounds in the churn holes, to break 1,131,000 tons of pillar ore (or 750,700 tons by long holes and 380,300 by churn holes).

Among the many United States equipment suppliers for this operation is Allis Chalmers Manufacturing Company. Two Allis Chalmers Diesel tractors can be seen above. Equipped with bulldozers, these machines are moving rock and earth in the mountainous region for construction of a road. Participating in the Toquepala project are: American Smelting and Refining Company, with 57¾ percent of the capital stock; Cerro de Pasco Corporation, 16 percent; Newmont Mining Corporation, 10¼ percent; and Phelps Dodge Corporation, 16 percent.

If you convey this . . .

you need this . . .



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Quaker Rubber's fire-resistant, flame-retarding belt actually *exceeds* the U. S. Bureau of Mines essential standards for underground mine safety.

The specified flame test permits burning up to 1 minute. But when the test is made on Quaker's belt, the flame is extinguished *instantly*. What's more, afterglow disappears in about one-third the time required by Bureau standards.

This belt is also lightweight and highly flexible. It has good troughability, yet is tough enough to take shock impacts and heavy, jagged loads. Made in any length. Widths up to 72".

Next time, specify "Fire Resistant U.S.B.M. 28-11" from your Quaker Rubber or Quaker Pioneer Rubber distributor. You'll like the savings . . . and the service.

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INTERNATIONAL

SPAIN—The Ministry of Industry has issued a directive which will make it impossible for foreign firms to participate in zinc mining and production in Spain. The directive states that Spanish interests applying for permission to develop zinc ore deposits must show that their capital is exclusively in Spanish hands, and that their board and management are composed of Spanish nationals.

HUNGARY—Refugees arriving in Austria report that anti-Russian rebels at Mecsek in Hungary have blown the uranium mines "sky high" to keep them from producing for the Soviets. The mines are said to be so damaged that they cannot operate for several years.

EIRE—Drilling operations by *Can-Erin Mines Ltd.* at the *Bearhaven* or *"Hungry Hill"* group of copper mines in west County Cork are progressing satisfactorily, and equipment for a mining plant is being installed at the 1,800-foot main shaft of the *Mountain* mine. A hoist, skip, tracks, heavy duty pump, and complete assay laboratory will soon be in use. Ore was discovered recently when a six-foot core section returned an average grade of 8.5 percent copper. The hole, drilled from surface below the old Coom workings, 2,500 feet southeast of the Mountain mine, cut 60 feet of copper mineralization. A two-foot section 18 feet further down averaged 4.7 percent copper.

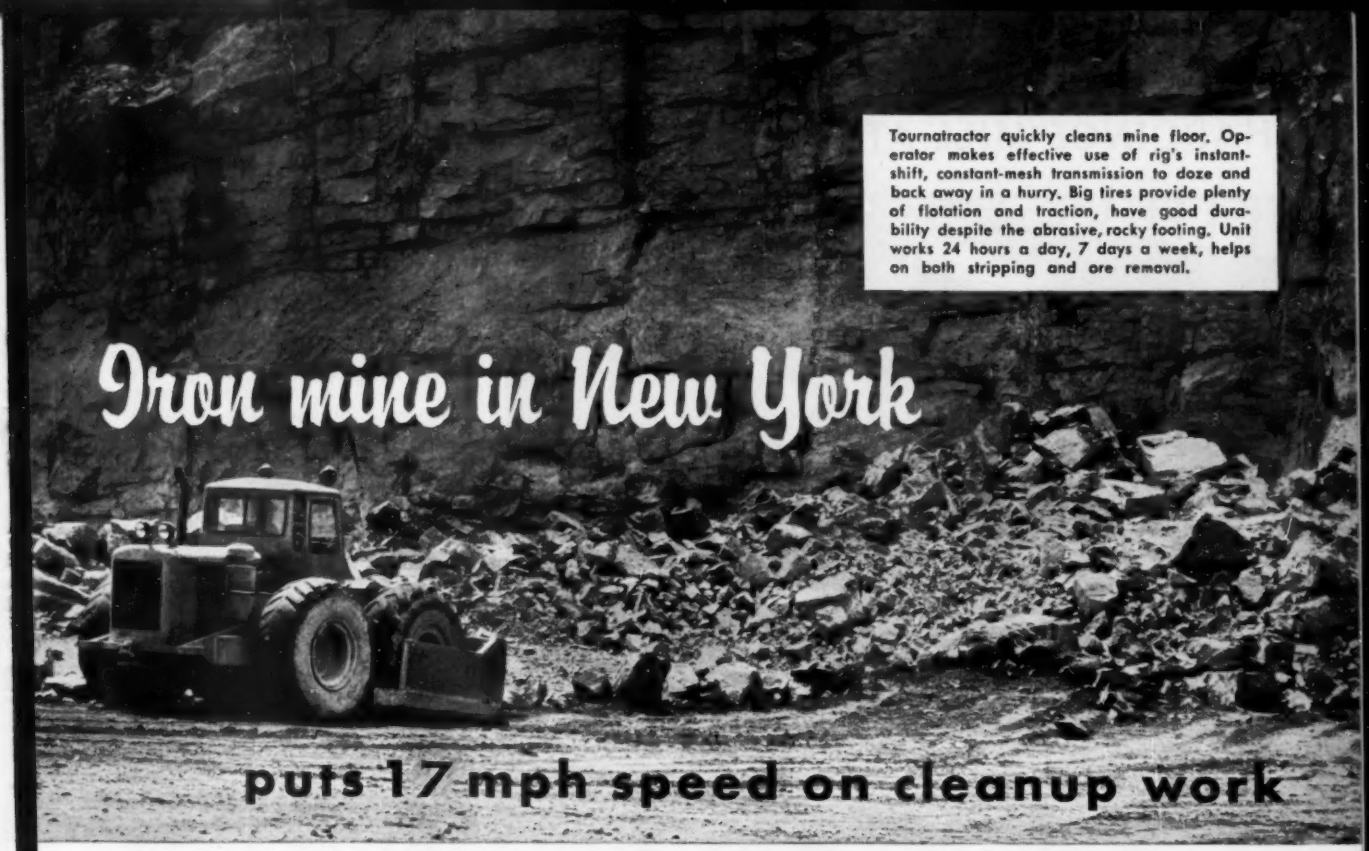
FINLAND—A copper deposit has been discovered at Suonenjoki, central Finland. It is about four kilometers long and several hundred meters wide and is said to contain more copper than the Finnish *Outokumpu* mine, the largest copper mine in Europe.

SWEDEN—A peak production record of 13,100,000 tons of iron ore was made during the 1955-56 season by *Luossavarra-Kiirunavaara Aktiebolag*, which will be completely state-owned by October. Sales totaled 714,300,000 crowns. During the last season 12,000,000 tons of ore were produced with a total sales value of 615,500,000 crowns. This season's net profit was only 179,700,000 crowns compared with 186,600,000 crowns last season; the difference was chiefly due to increased taxes.

EIRE—*The Abbeytown Mining Company, Ltd.*, a subsidiary of the *Johannesburg Consolidated Investment Company*, reports satisfactory profit and development at its operations in County Sligo.

AUSTRIA — Beryllium deposits were discovered over a century ago in lower Austria but mining was considered unprofitable until recent discoveries added to the versatility of beryllium. *Aluminiumwerk Ranshofen* has found that the addition of small amounts of beryllium to alloys of aluminum magnesium prevents losses of magnesium during the casting process.

GREECE—The Greek government has granted permission to a Norwegian firm, *Veibygg A/S*, to mine manganese ore in Greece. The company's prospecting work in Larizza, central Greece, has resulted in small-scale mining operations. Full-scale operations will be run by a specially formed subsidiary of Veibygg.



Tournatractor quickly cleans mine floor. Operator makes effective use of rig's instant-shift, constant-mesh transmission to doze and back away in a hurry. Big tires provide plenty of flotation and traction, have good durability despite the abrasive, rocky footing. Unit works 24 hours a day, 7 days a week, helps on both stripping and ore removal.

Iron mine in New York

puts 17 mph speed on cleanup work

- **Rubber-tired tractor clears mine-floor after blasting**
- **Rig also cleans up around 4½-yd. shovel**
- **In winter, plows snow from haul roads and blast areas**

With drilling and blasting done throughout the day along an ore body two miles in length, this New York open-pit iron mine has a major cleanup problem. They have licked the problem with the speed and maneuverability of a rubber-tired Tournatractor.

On the relatively long runs between operating faces, this 17 mph rig makes a much faster trip than could a crawler-tractor. Another advantage of Tournatractor is that it does not cut-up the surface of the haul roads like a crawler does.

During winter, Tournatractor also finds time to plow snow from the pit roads and loading areas. It also clears areas to be blasted. This keeps snow from getting mixed in with the shot rock and later from causing trouble inside the crushers.

"Excellent on night shift"

For work on the night shift, owners are particularly pleased with the lights on their Tournatractor. They find that "night work does not slow this rig nor put any limitations on areas where it can travel or work."

Write us if you would like more information on this high-speed, 208 hp rubber-tired tractor. Or, if you prefer, we will be happy to send you owner-verified field reports on Tournatractor handling work similar to yours.

The ore body being mined here was discovered in 1810 by engineers surveying a military road between Albany and Ogdensburg. Only a small amount of iron was removed, however, until 1944 when modern methods of beneficiating magnetite and low-grade non-magnetic martite ores made the operation profitable. This year, 1,300,000 gross tons will be processed. All will be taken from a deposit slightly over 2 miles long and 200′ to 1400′ wide. Iron content averages 24%. Overburden includes a structural hanging wall of granetized gneiss, plus up to 60′ of glacial drift (mostly sand, hardpan, and boulders). Height of operating faces is set at 50′ except for some first cuts of 100′. Drilling is made with 42-T and 50-T churn drills, with chrome-nickel-moly bits of 4340 grade. Nine-inch primary holes are spaced about 23′ apart and burden at toe is kept as close to 20′ as possible. Every pound of explosive breaks about 2.35 gross tons of crude ore. This is loaded by 4½-yd. shovels into 22-ton rear-dumps and transported to the 54 inch primary crusher. Rock chunks too big to pass the 4½-yd. dipper (about 1 chunk per 40 tons of crude ore) are reduced to handling size by a 4-ton drop ball handled by a truck crane.

Tournatractor—Trademark T-751-M-bw

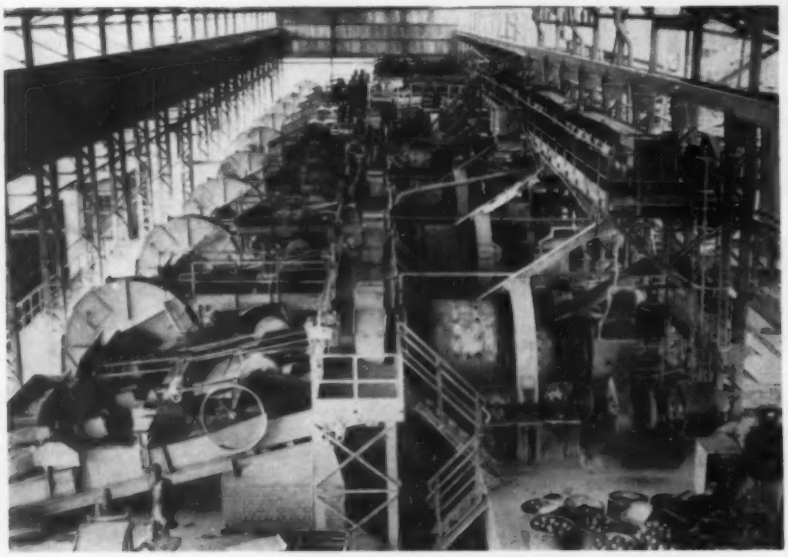
LeTourneau-WESTINGHOUSE Company

Peoria, Illinois

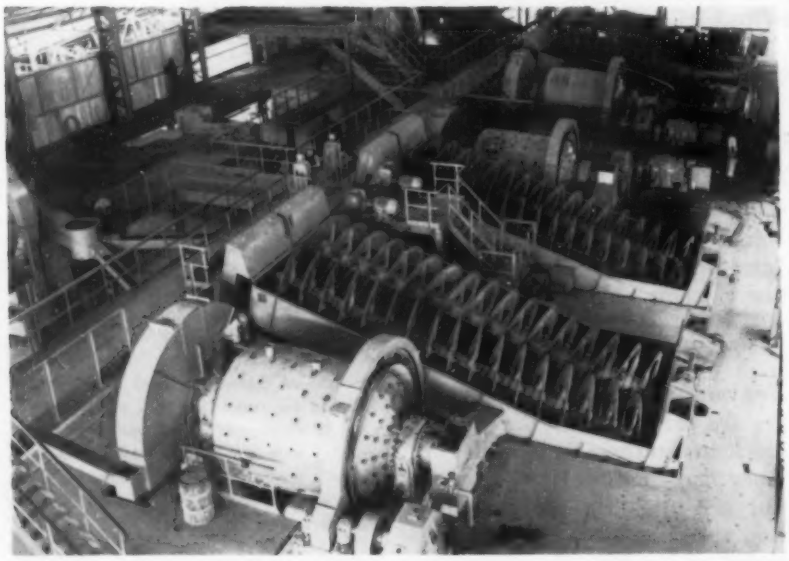
A Subsidiary of Westinghouse Air Brake Company

WHERE QUALITY IS A HABIT

HARDINGE MILL AT UNION MINIERE



Milling plant at Kolwezi Concentrator, showing ten Hardinge 8' x 48" Conical Ball Mills in closed circuit with rake-type classifiers, grinding a total of 5000 tons daily of copper-cobalt ore. There are a total of 34 Hardinge Conical or Tricone Mills in operation at the various Union Miniere plants.



Four Hardinge 9'-3'-6'-8' Tricone Mills grinding sulfide copper ores and mixed ores at Kolwezi. Four additional Tricones are in operation at another plant. There are also 11 Ruggles-Coles Dryers, made by Hardinge in the Union Miniere operations.

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INTERNATIONAL

NEWFOUNDLAND—Extensive diamond drilling by *Advocate Mines Ltd.* on its 1,575-square-mile concession has blocked out about 13,500,000 tons of asbestos, according to company reports. The major occurrence lies in the Burlington Peninsula between Notre Dame Bay and White Bay on the northeasterly part of the island. At present 12 diamond drills are in operation seeking to expand these reserves. The ore occurs in a saucer-shaped structure and lies, for the most part, under an average 250-foot capping of finely grained peridotite, but does extend to surface on the contact walls. Other fibre occurrences have been found along the favorable belt with indications of a second deposit 2½ miles south of present workings.

ONTARIO—*International Nickel Company of Canada* has undertaken preliminary construction of a new $12,500,000 concentrating plant adjacent to the *Levack* mine. The *Foundation Company of Canada* has the contract for the work. Operation date is set for 1958. The mill will have a rated capacity of 6,000 tons per day, and will produce both nickel sulphide and copper sulphide concentrates. The nickel concentrate will then go to Inco's Coniston smelter, and the copper concentrate will be treated at Copper Cliff.

BRITISH COLUMBIA—The old *Velvet* mine in the Rossland area has been returned to production by *Mid-West Copper & Uranium Mines, Ltd.* The company has developed an estimated three years' supply of gold-silver-copper ore which is being put through a 150-ton concentrator, the former Whitewater mill which was moved from Retallack and installed below the main haulage level. A 1,200-foot aerial tram connects with the crusher plant. Concentrates are to be shipped to the Tacoma, Washington smelter.

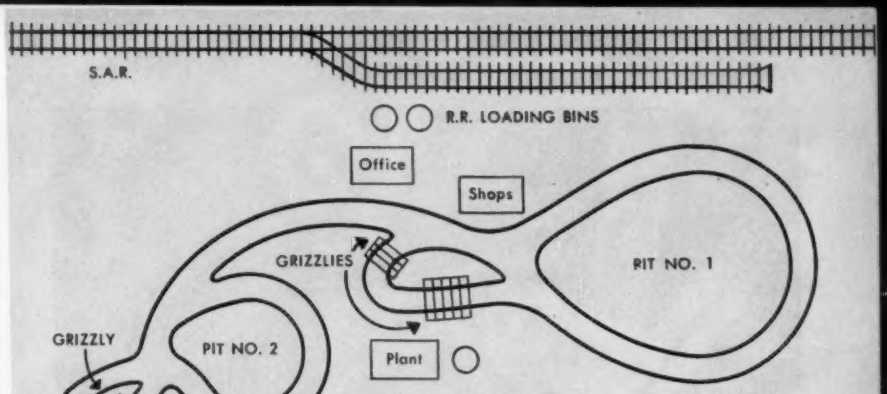
SASKATCHEWAN—Officials of *Lorado Uranium Mines* expect the new 500-ton mill to be in production by mid-April and have already ordered equipment for expanding the operation to 700 tons in the near future. The company now plans immediate resumption of underground exploration and development work at the *Ilco* property. A new plant has been installed at the mine which is about four miles from the mill. A new headframe, hoist, hoistroom, Diesel electric generator and water tank are among the new units.

ALASKA—*Kenai Chrome Company* was not able to complete and operate its new concentrating plant this winter because of insufficient ore. An early snowfall, coupled with freezing weather, prevented trucking of ore to the mill site on Jakolof Bay so that further work on the plant was not justified.

ONTARIO—The value of Canadian mineral production in 1956 set a new record at $2,067,699,096. This represented a 15 percent increase over the 1955 total of $1,795,310,796. Crude petroleum ranked first in production value, followed by copper, nickel, iron, and gold. Ontario provided 30 percent of the production, amounting to $641,000,000. Quebec provided 20.6 percent ($427,000,000) and Alberta 19.8 percent ($409,000,000).

Rubber-tired haul units reduce maintenance costs

at South African sand pits



In this South African pit, D Tournapull self-loads an average of 6 cu. yds. of foundry sand in 100 ft., according to Manager J. H. McIlrath. Time: ½ minute. Sand moisture content of 5 to 20% helps speed self-loading, also increases traction and tire flotation. Tournapull's 65 in. tires have been inflated to 35 lbs. pressure, for work in this material.

Two self-powered D Tournapull-Scrapers handle all special sand mined from two valuable pits owned by Industrial Sand & Engineering Co., Ltd., Pretoria, Union of South Africa. These two pits, 15 miles west of Pretoria, in Moot Valley, produce 75% of all the sand used in South Africa's glass and foundry industries.

Haul 14,060 metric tons a month

Working 45 hours per week, the two Tournapulls move about 15,500 tons of glass sand (silica), foundry sand, and overburden every month.

In typical operation, "D's" self-load an average of 6 cubic yards of moist foundry sand in ½ minute. Hauls of about .2 mile, to the grizzlies located at each pit, take 1½ minutes. Each of the D Tournapulls completes a typical cycle of more than .8 mile in 4.4 minutes.

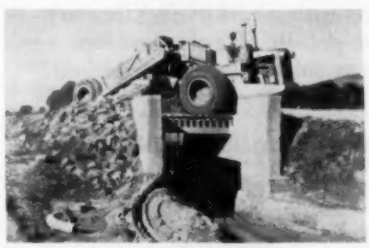
Handle maintenance, construction

This high production rate is partly due to the good condition of the sand haul roads, maintained and compacted by the versatile Tournapull Scrapers themselves.

Due to their fast, efficient sand-moving, Tournapulls have plenty of time for such road maintenance, in addition to their regular mine hauling duties. In their spare time, Tournapulls are also assigned to build dams where necessary, and to act as utility hauling tools.

Company formerly used 57 hp crawler-tractors and scrapers to haul the abrasive sand at these two pits. Maintenance and repair costs, however, ran excessively high on track-type haul units. Pins and bushings had to be replaced after every 400 hours of use.

In sharp contrast, Tournapull tires are giving more than 3,000 hours of use, working in material that representatives for the crawler manufacturer called the "most abrasive" they ever encountered.



Tournapull dumps load of special moist sand into grizzly in an average of 18 seconds. Industrial Sand & Engineering Company mines only top grade glass and foundry sand at the company's two pits in Moot Valley.

"It was a lucky day when we purchased the Tournapulls," says Manager J. H. McIlrath. "We were getting only 400 hours of track life."

Liked one, bought another

For an entire year, a single Tournapull mined all sand handled here, and hauled it to the washing plant. When company officials decided to add a second haul unit, they showed their satisfaction with Tournapull performance by purchasing a second "D".

The same high-speed mobility, and low maintenance that contribute to Tournapull efficiency in this successful mining work could benefit *your* projects, too. Before you buy another set of tracks, investigate the many advantages that rubber-tired Tournapulls can give you. Write us for more information.

Tournapull—Trademark Reg. U.S. Pat. Off. DP-1187-S-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

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Match the capacity of your processing equipment—eliminate erratic underfeed and overfeed—smooth out production cycles.

SYNTRON "Vibra-Flow" Vibratory Feeders fill that important gap between storage and processing. They provide a smooth, even flow of bulk materials—hot or cold, dry or damp, from powders to chunks—to grinders, breakers, hammer mills, ball mills, driers, coolers, screens, belt conveyors and other types of processing equipment. And, what is most important, the flow rate is instantly adjustable, from minimum to maximum, to meet production schedule changes.

Investigate the production possibilities with SYNTRON Vibratory Feeders in your operation. Send us the details of your problem—our application engineers will be glad to submit recommendations.

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Write for complete catalog data—FREE!

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INTERNATIONAL

BRITISH COLUMBIA—Fire destroyed the mill of *Silbak Premier Mines Ltd.* in the Salmon River mining district, 16 miles from Stewart. The loss was estimated at $500,000. The company is managed by *Selukwe Gold Mining & Finance Ltd.* of London. Primarily a lead-zinc producer, the mine only recently resumed production after a shutdown in 1953 because of low base metal prices. The mill will be rebuilt.

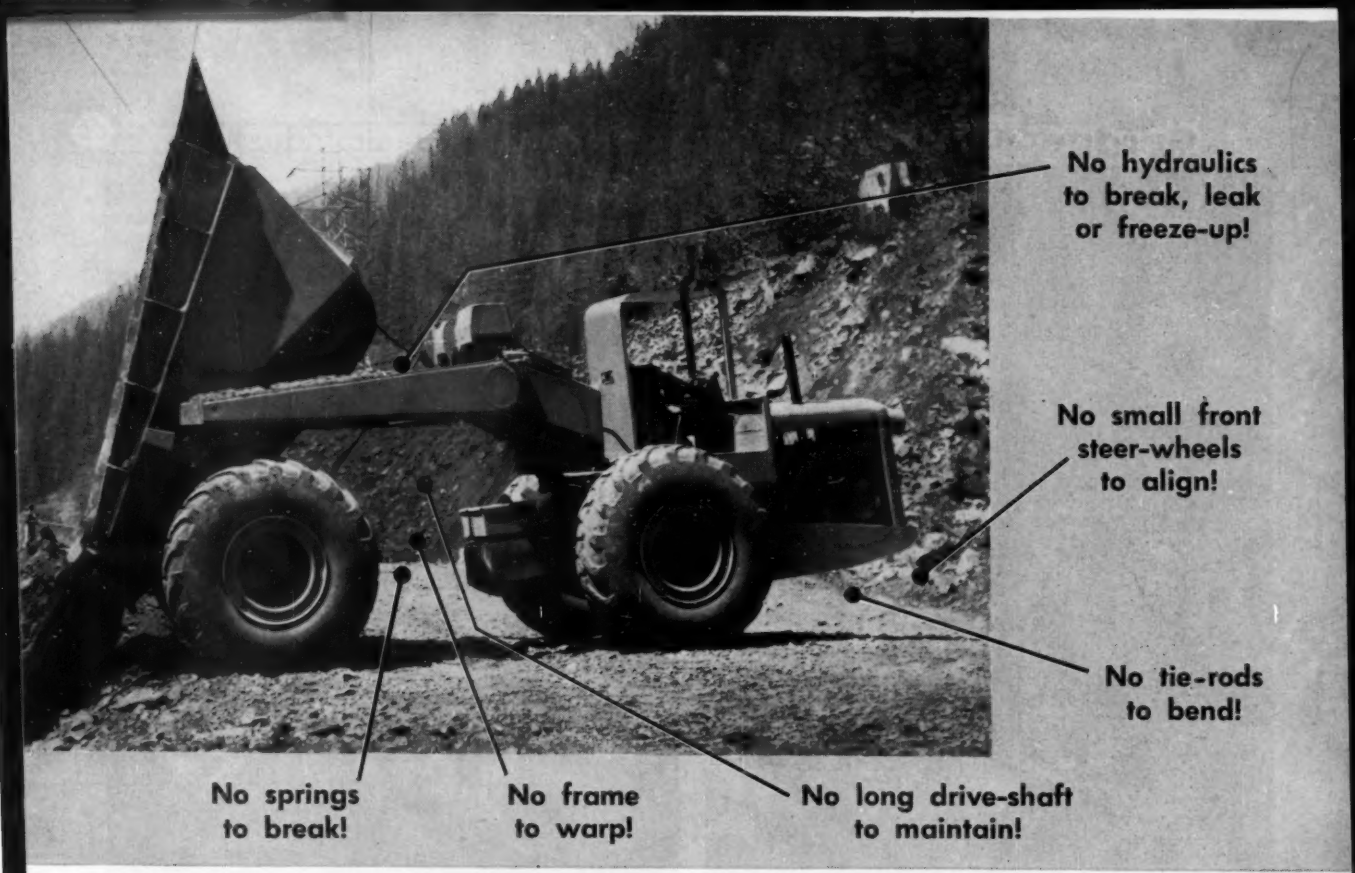
QUEBEC—*Patino of Canada* has acquired controlling interest in the *Copper Rand Chibougamau Mines, Ltd.* and *Chibougamau Jaculet Mines* with a fund of $16,500,000 available for bringing the two mines into production. Both firms will retain their separate identities with Patino having a majority on the board of each. One mill will be provided for both companies. At Copper Rand development work is from three shafts.

ONTARIO—*Newkirk Mining Corporation Ltd.* has requested approval from stockholders for a name change to *Continental Mining Corporation Ltd.* In the opinion of the directors, this name would more aptly describe the broad scope of the firm's activities. The company also plans to purchase *Central Mining Services, Ltd.* which provides accountancy, secretarial, and head office services for mining companies, thus supplementing the engineering and technical services already offered by another Newkirk subsidiary, *Continental Mines Management Ltd.*

TURKEY—A new firm called *Turk Molibden Sirketi (Turkish Molybdenum Company)* has been organized to operate a molybdenum mine 70 kilometers south of Bursa. A flotation plant will be installed soon. The estimated reserve is reported to be about 500,000 tons. The mineralization in the deposit occurs in fractures in a stock and averages 0.4 percent Mo.

INDIA—An agreement has been reached between Japan and India for the purchase and sale of iron ore for the period from 1957-1958 to 1961-62. India's *State Trading Corporation* will supply 7,200,000 tons to leading Japanese steel mills over the five-year period. Import price for the first year will be 84 shippings per ton f.o.b. Indian ports for 65 percent Fe ore. Japan will purchase 1,300,000 in the 1957 fiscal year; 1,400,000 in 1958; and 1,500,000 in 1959. In 1960 and 1961, 1,500,000 would be imported in principle, but actually this will depend upon the supply and demand situation for steel in Japan at that time.

CYPRUS—*Cyprus Sulphur and Copper Company*, a subsidiary of *Esperanza Copper & Sulphur Company*, has located an ore body of chalco-pyrite, and to date 250,000 tons of ore are available for economical open-pit mining. There should be a substantial tonnage for sale during the next two years without any further drilling. The decision to concentrate on the new discovery would mean delay in bringing the modified *Limni* plant into production but it appears impractical to go ahead with both projects simultaneously without the provision of further


No hydraulics to break, leak or freeze-up!
No small front steer-wheels to align!
No tie-rods to bend!
No springs to break!
No frame to warp!
No long drive-shaft to maintain!

Cuts your hauling costs!

Tournapull Rear-Dump overcomes most maintenance problems of conventional haulers

Construction of Tournapull Rear-Dump is radically different (and much simpler) than that of a conventional heavy-duty hauler. In place of a foundation frame and body sub-frame, Tournapull Rear-Dump hitches rear and front wheels through a horizontal yoke extending back from the kingpin, and pivoted to body itself just above and ahead of rear wheels. Body is simpler, much stronger . . . has no frame and sub-frame to get out of line.

Look at the photo above . . . note the absence of springs, spring hangers, and tie rods. Low-pressure tires adequately absorb the shocks of rough haul-road travel and shovel loading. Eliminated are spring maintenance, replacement time, and cost of spring parts.

Front-wheel drive and kingpin-type power steer helps simplify Tournapull construction, too. No longer must power be carried back to the rear through a drive-shaft. Bearing and lubricating problems of a long drive-shaft are eliminated. No longer is steering handled by small front wheels subject to "bulldozing" and misalignment. There are no tie rods, no hinged steering connections to become twisted or bent.

Nor do you have the troubles of hydraulic hoists or gravity dumping with these Rear-Dumps. Dump is by an electric winch, that lifts the body up on twin cables. Operation is under complete control at all times — with positive power for dump and return controlled by an electric switch on the dash. There are no oil seals, hydraulic pumps . . . no high-pressure lines and jacks to keep tight . . . no freezing up in cold weather as with hydraulics. There are no shock loads as in gravity dumping. You save on regular maintenance time because there is no hoist mechanism to check . . . only a few places to inspect and lubricate.

Let us show you how these savings can put money in *your* pocket. For proof, we'll be glad to show you performance figures from a job like yours. Or, if you wish, we'll give you names and addresses of nearby owners of Tournapull Rear-Dumps, so you can check the facts for yourself.

Model D — 11 tons, 138 hp

Model C — 22 tons, 208 hp

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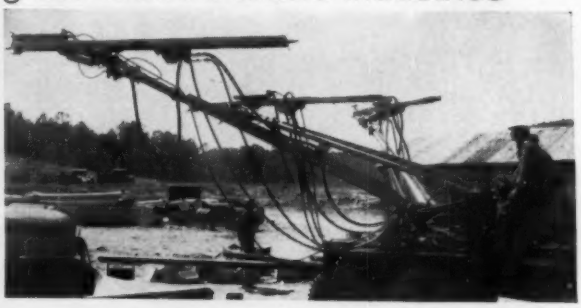

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financing. Temporary financing will be required between now and spring when weather conditions will enable ore shipments to resume.

BURMA—*Consolidated Tin Mines of Burma* is reported to have accepted the government's offer to renew its mining leases for another five years. This is much less than they would normally be entitled to but this is the best that can be done under existing circumstances. In view of this, the company is unable to take steps to re-equip the mine for operation of the claims on a long-term basis. Production in the last financial year amounted to 398 tons, compared with 154 tons in the previous year.

JAPAN—*Mitsubishi Metal Mining Company* is said to be considering an increase in copper production both at Naoshima smelter and at Osaka refinery, in order to be ready for the 10,000 tons of copper concentrate expected to be received this year from *Atlas Consolidated's* operations at Toledo in the Philippine Islands. Production at both facilities will be increased from 2,000 to 3,000 tons. At the same time, a switchover from dilute sulphuric acid to concentrated sulphuric acid production is also planned. Estimated total cost of these projects is 1,500,000,000 yen.

TURKEY—The German firm of *Krupps* has completed its inspection of all iron ore deposits in Turkey. Some 34 different deposits were visited by the firm's geologists. In the coming months it will be determined which of the deposits will be worth more intensive investigation. Krupps is doing the work as consultant for the Turkish government.

BURMA—Mining and drilling operations were resumed at the *Mawchi Mines Ltd.* property in January 1956 but production for the year, including lessees' operations, amounted to only 153 tons of mixed tin-wolframite concentrates. This is because Mawchi has found it virtually impossible to replace the traditional Ghurka labor employed before the war. Finding the adequate number of employees for underground work is still the company's main stumbling block. In an effort to build up an adequate labor force, consideration is being given to contract labor forces from abroad. A team of government experts recently visited the property to evaluate the firm's assets with a view to operating as a joint venture but the loss of the greater part of the company's records during the Japanese occupation is delaying these negotiations considerably.

JAPAN—*Dowa Mining Company* has completed erection of another new Fluosolids reactor unit and sulphuric acid plant at Kosaka refinery in the Tohoku district, Akita Prefecture. The sulphuric acid plant uses waste gases from the smelter. (See MINING WORLD, April 1956, page 60.) The plant is capable of producing 3,000 tons of sulphuric acid monthly. Zinc production will increase from 240 tons to about 600 tons monthly.

MALAYA — *Southern Kinta Consolidated Ltd.* has a fleet of nine dredges in operation. During the next five years, the following dredges are expected to deplete their present reserves: *Kampar Malaya No. 1* in 1958; *Penawat* in 1960; *Kampar Malaya No. 2* in 1961; *Southern Kampar No. 2* in 1961; and *Kinta Dredges No. 1, 2, and 3* in 1961. One of these dredges will be moved to the Bernam section, but additional dredging areas for the remaining dredges will have to be found. The company intends to spend considerable sums to achieve this. In addition to this expense, the firm also must meet its share of the Tin Buffer Stock which is expected to be well over £250,000. Also there will be a river deviation in the Rasa area once the dredge is operating there which will cost another £100,000.

TURKEY—Construction of the hydroelectric power station at Hazar has been completed. It will supply power to the copper mines at Ergani, the chrome mines at Guleman, and the province of Elazig. Its present capacity is about 6,000 kilowatts; this is to be increased to 13,200 kilowatts by the installation of two other generator units.

MEXICO—The *Mazapil Company* located at Concepcion del Oro, state of Zacatecas, has increased smelting capacity at its property from 500 metric tons per day to 1,000 metric tons of copper ore and concentrate. The firm produces a blister copper with gold and silver contents. The ore comes from the firm's *Aranzazu* mines and also from custom operators in the district.

BRAZIL—Seven Japanese steel mills reportedly have contracted to buy 120,000 tons of iron ore from Brazil annually. The ore, containing 68.5 percent Fe, will come from the *Itapira* mine, and will be sold at $13.90 per ton f.o.b. Brazilian ports. In 1956 *Fuji Iron and Steel Company*, one of the seven mills, received 50,000 tons from Itapira at $12.75 f.o.b. Brazil.

SURINAM—A new 4,500-hp. Diesel electric dredge has been built for *Surinam Bauxite Company* for stripping. The company operates properties at Rikanau near the Cottica River, and at Onoribo and Rorac Hills near the Suriname River.

VENEZUELA—*Orinoca Mining Company*, a subsidiary of the *United States Steel Corporation*, has ordered 11, giant, six-wheel Mack dump trucks designed to carry iron ore down the steel Cerro Bolivar roads to ore-loading railroad platforms. Because of the 8 percent grade, special braking devices have been incorporated in addition to conventional friction brakes for greater safety.

CUBA—The *El Francisco* chrome mine, owned by *Companio Minera Occidental Bosch*, S.A. has closed down its operations. In October the mine exported 368 tons of ore, as compared with the *Cayo Guam*, *Chromita*, and *Delta* mines near Moa which exported 8,819 tons and the *Matahambre* mine which exported 4,159 tons of chrome.

PERU—Two Japanese firms and a Peruvian firm are reported to be establishing a joint mining company. The Peruvian company holds an option on iron ore deposits close to Chala, Arequipa, believed to contain about 20,000,000 tons of 61.0 percent iron ore. Production potential is estimated at about 1,000,000 tons per year which would be exported to Japan.

MEXICO—*Eulalio Gutierrez*, manager of the *Noche Buena* mine, has taken a lease on the *La Blanca* property located in the Avalos district at Conception del Oro, state of Zacatecas. A shaft is being sunk to cut the vein that outcrops on the property. It is believed that this vein is a continuation of the one being developed at the Noche Buena. George Martinez Morton, owner of the La Blanca property, states that they expect to mine ore similar to that of the Buena Noche, which contains gold, silver, copper, and lead.

BRAZIL—Negotiations between Japanese industrialists and the Brazilian government have been resumed and it appears that a company will be formed to build a steel plant in the Rio Doce Valley or Paraopeba Valley, state of Minas Gerais. The Japanese will subscribe up to 40 percent of the 3,000,000,000 to 4,000,000,000 cruzeiros capitalization, and will furnish two-thirds of the machinery to be imported. Annual capacity will be 500,000 tons of steel. This would bring Brazil's production to 1,800,000 tons of steel annually by 1960; however, the country expects its demands to total 2,300,000 tons annually by that time.

CUBA—The Ministry of the Treasury has released the following figures on mineral exports from Cuba during the first six months of 1956: copper 32,924 tons; iron 69,221 tons; chrome 15,522 tons; nickel 10,233; manganese 130,356 tons; miscellaneous, including silica, gold, hematite, magnetite, and barite, 4,605 tons.

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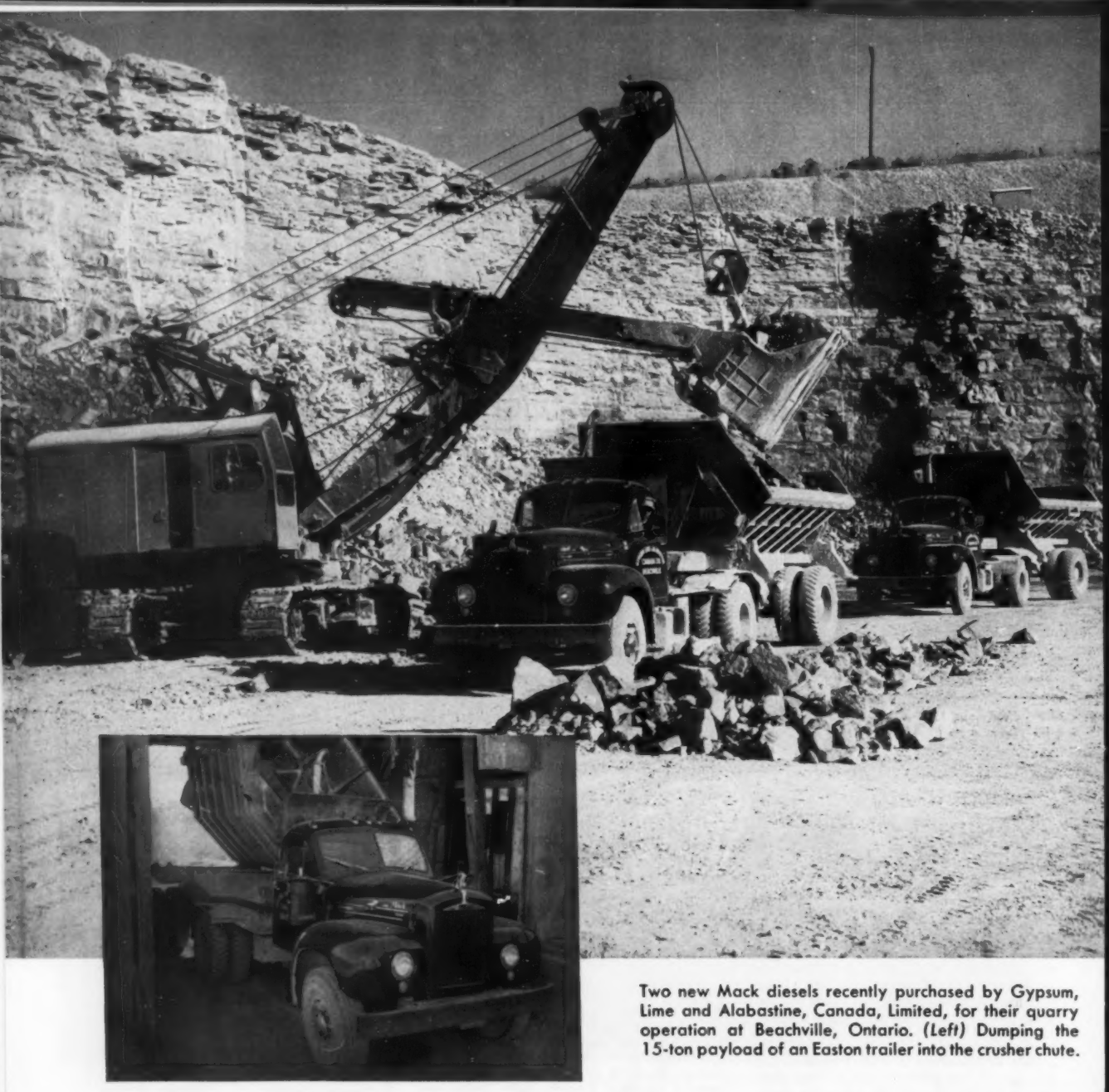

Two new Mack diesels recently purchased by Gypsum, Lime and Alabastine, Canada, Limited, for their quarry operation at Beachville, Ontario. *(Left)* Dumping the 15-ton payload of an Easton trailer into the crusher chute.

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INTERNATIONAL

ARGENTINA — Exploratory tunneling and mine preparations are continuing at the wolframite deposits of *Cerro El Bronce* property of *Compania Minera Arrequintin*, province of San Juan. Preliminary work was started in 1954. In 1955 a road was built to connect the mine to the plant, and milling facilities were installed to treat 30 tons per day of ore.

MEXICO — *International Hermes* has signed a contract with a Mr. Munguia, owner of the *Rosa Amarilla* copper mine located at Cuautitlan in the state of Colima. The ore is a low-grade copper, which, after sorting, is expected to assay 8 percent copper. The low-grade ore will be leached with a solution of sulphuric acid to produce copper cement.

REPUBLIC OF THE PHILIPPINES —More than 100,000 tons of ore carrying lead, zinc, and copper have been blocked out in a lead property near Batobalani in the Paracale mining district. Paul Childress, a geologist for *A. Soriano and Company*, first located the deposit while making a geological reconnaissance of the district. Development work is continuing under the direction of *Philippine Iron Mines*.

QUEENSLAND—*Metals Exploration N. L.* has been granted an authority to prospect over 3⅛ square miles near Mount Novit, about eight miles south of *Mining Corporation N. L.'s* holdings near the leases of *Mount Isa Mines Ltd.* At the northern end of the prospect, four mining leases have been staked covering an area of 1,280 acres. These cover a line of gossans which may be a possible extension of the Mt. Isa lode. The Mining Corporation reports that diamond drill hole No. 2 on the company's Mt. Isa line of lode leases has advanced to 1,350 feet.

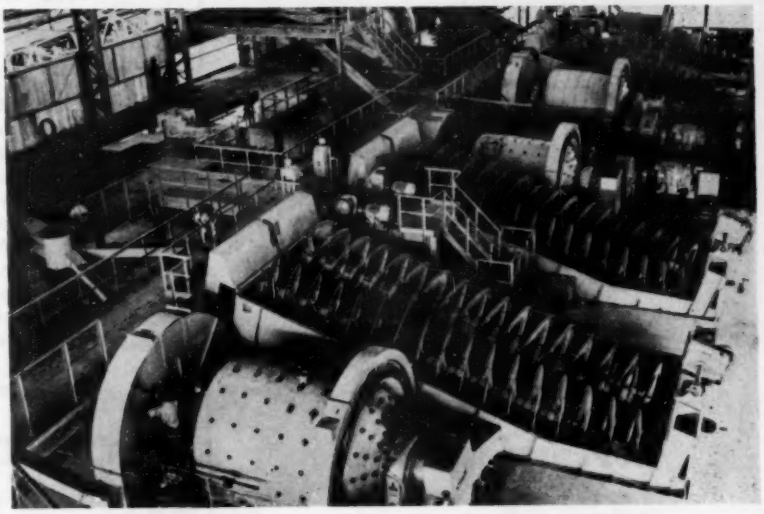
REPUBLIC OF THE PHILIPPINES—*Marinduque Iron Mines, Inc.* expects to start producing copper at its *Sipalay* project this month. Company officials expect a new production of 1,670,000 pounds of copper per month (estimated on 26 working days) by milling 1.0 percent copper ore and assuming 80 percent recovery from the mill and 95 percent recovery from the smelter. The company also has decided to erect a smelter and a fertilizer plant in Sipalay.

NEW GUINEA—*Bulolo Gold Dredging Ltd.* has obtained a satisfactory insurance settlement for the sinking of No. 7 dredge in May 1956. No. 4 dredge is expected to exhaust its available ground and to shut down before June of this year. Sluicing of bench gravel is expected to continue profitably for some years.

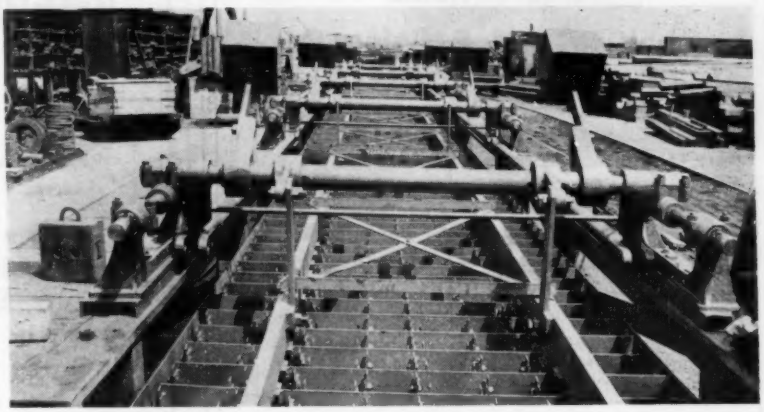
REPUBLIC OF THE PHILIPPINES—*United Paracle Mining Company* has obtained an option from the *Milagros Mining Company* on a group of claims in the municipality of Tigbao, Masbate. The claims are predominantly a copper porphyry structure containing chalcopyrite, malachite, azurite, bornite, and chalcocite. Samples have assayed from 0.48 to 52.0 to 58.0 percent copper. Exploration, geological work, and mapping are already in progress under the supervision of *Marsman and Company's* technical staff. Diamond drilling will start soon.

CIW AT UNION MINIERE

Union Miniere uses both U. S. and foreign *CIW* manufacturing facilities



AKINS CLASSIFIERS—Photo shows four of eight 78" Duplex Akins Classifiers built in the U. S. for Union Miniere du Haut Katanga. Also, one 30" Simplex Akins, one 45" Akins Simplex and six 54" Akins Simplex Classifiers were fabricated by Head, Wrightson and Co., CIW's representative in England and South Africa.



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QUEENSLAND—*Consolidated Zinc* of Melbourne and London has organized a new company in Queensland to develop bauxite deposits on the west coast of Cape York Peninsula. The firm is *Commonwealth Aluminium Corporation Pty. Ltd.* Many hundreds of tons of bauxite have been proven. *British Aluminium Company*, which has been engaged in surveying the hydroelectric power resources of Papua in association with the Commonwealth government, will be associated with Commonwealth Aluminium.

TASMANIA—The *Electrolytic Zinc Company of Australasia Ltd.* produced 103,964 tons of zinc in 1956, a record for the firm, and expects to increase this to 115,000 tons per year by the end of 1957. Further extensions to the refinery are being considered which would increase capacity to 140,000 tons annually. A plant of this size would be dependent more than ever upon the state government's ability to supply power.

NORTHERN TERRITORY—*New Merloo Gold Mines N. L.* at Tennant Creek reports that the geological team of *National Lead Company* (United States firm) is well advanced with studies on several projects. Drilling has started. Estralita shaft has been deepened beyond 150 feet and crosscutting is advancing south. Applications have been lodged for two leases just north of *Peko Mines N. L.* where "an interesting magnetic anomaly" exists.

FIJI ISLANDS—*Emperor Mines Ltd.* had a sharply reduced profit in the year ended 30th June, 1956. 149,000 tons of ore were milled against 156,000 the previous year at an average grade of 9.11 dwts. Reserves are 680,000 tons at 8.8 dwts., compared with 690,000 tons at 8.4 dwts., plus 265,000 tons of "indicated" ore at 7.5 dwts. Costs were higher during the year because of several factors including higher native labor rates. A vigorous development and prospecting program is under way and future ore prospects are good; as with most gold mines, however, prospects are clouded by a fixed product price and rising costs of production.

REPUBLIC OF THE PHILIPPINES—*Marsman and Company*, managers for *Itogon-Suyoc Mines Inc.*, report that expansion of the Itogon mill and rehabilitation of the *Suyoc* mine are progressing satisfactorily. The thickener and agitator equipment ordered from the United States are expected to be delivered in March for immediate installation. Reopening of prewar mine workings at Suyoc is proceeding with a 150-horsepower deepwell turbine pump installed recently to speed up the dewatering.

QUEENSLAND—Production of uranium oxide is expected to begin at *Mary Kathleen*, near Mt. Isa—Cloncurry, by early 1959. The United Kingdom atomic energy authority has contracted to purchase up to £40,000,000 worth.

WESTERN AUSTRALIA—*Western Titanium N.L.* at Capel, near Bunbury, is pressing ahead with its construction program and is completing the installation of 24 magnetic separators, four high intensity rolling type separators, and four electrostatic separators. Much of the equipment is made in Australia. Present indications are that keen buying of Capel ilmenite will come from Japan and the United States. It is possible that a titanium dioxide (titanium white) manufacturing industry will be established at Bunbury. The present (only) Australian producer of TiO_2 pigment is *Australian Titan Products Ltd.* at Burnie, Tasmania.

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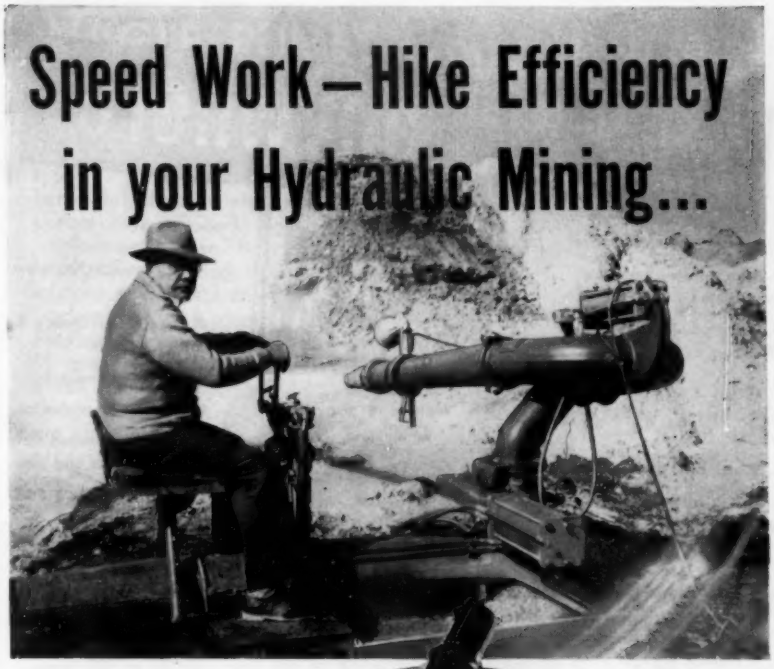

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INTERNATIONAL

Production of mineral at Capel is expected to be in full swing during the first quarter of 1957.

INDONESIA—The government-owned asphalt mine at Buton, being developed by the *Buton Asphalt Company*, is currently producing 40 tons per day.

UNION OF SOUTH AFRICA—*Marble Lime and Associated Industries Ltd.* has purchased the *Kroondal* property in the western Transvaal and a concentrating plant has been erected thereon to treat the chrome ore.

SOUTH WEST AFRICA—Further applications for diamond concessions in the territory have been reported (see MINING WORLD, December 1956, page 74). The most recent application granted was that to *Planned Investment Trust Ltd.* The concession covers base minerals, as well as diamonds, in almost all of the Warmbad district extending north from the Orange River.

FEDERATION OF RHODESIA & NYASALAND—*Kansanshi Copper Mining Company, Ltd.* has initiated some small production of oxide ore, which is being transported to the Nkana smelter for treatment. The firm has also commissioned its concentrator for limited initial production of copper sulphide concentrates. Revenue from this operation will provide part of the funds being used for further exploration and development.

LIBERIA—*Columbia-Southern Chemical Corporation* is undertaking exploration for titanium and other minerals in undeveloped areas of Liberia. The work is authorized under an agreement signed by the company and the Liberian government in June 1956. The agreement also provides for mining operations if such minerals are found.

UNION OF SOUTH AFRICA—The *Vlakfontein Gold Mining Company, Ltd.* has purchased from the *West Vlakfontein Company* its reduced mining lease over a very small claim area which includes a completed shaft, certain underground workings, its interest in mineral rights over the adjacent 5,686 claims, and certain other assets. The West Vlakfontein property adjoins the southern boundary of the *Vlakfontein* mine, with which it has been connected by an underground haulage drive, and lies west of the Sub Nigel and northwest of the *Spaarwater* mine. The West Vlakfontein Company obtained disappointing development results on both the Main and Kimberley Reefs, but, from Vlakfontein's point of view, there is probably sufficient marginal ore at least in the northern section to make the acquisition an attractive proposition, while the shaft acquired will facilitate easier mining operations and improved ventilation in the southern section of the Vlakfontein mine.

UGANDA—Formal ceremonies on November 23, 1956 marked the official opening of the *Kilembe* copper mine of *Kilembe Mines Ltd.* Also officially dedicated were the processing plant at Kilembe, the metallurgical plant at Kasese, and the smelter at Jinja, 260 miles east of Kasese. The 208-mile Uganda extension of the East African

Railway was also dedicated. The $22,000,000 project is owned by a group—*Kilembe Copper Cobalt Ltd.*, a wholly owned subsidiary of *Frobisher*, holds 70 percent; *Colonial Development Corporation*, 20 percent; *Uganda Development Corporation*, 10 percent. Initially the mine will process about 480,000 tons annually but this will ultimately be increased to 720,000 tons.

TANGANYIKA—*Uruwira Minerals Ltd.* reports that its mine and mill have now reached capacity operation. Average tonnage of ore treated during the last three months of the fiscal year ended September 30, 1956 was 30,823 dry metric tons per month. Ore reserves at year's end were about 2,686,000 dry metric tons. During the year 169,827 tons of ore were milled, yielding 7,008 tons of concentrate averaging 42.7 percent lead, 11.45 percent copper, with some silver and gold. Exploration and development of ores immediately adjacent to the known ore body is now in progress.

FEDERATION OF RHODESIA & NYASALAND—*Bancroft Mines Ltd.* has nearly completed the first phase of opening up two of its three ore bodies and initial production will start this year. The second phase will raise copper output capacity to about 85,000 tons a year, and is expected to be completed by about 1960. Ore reserves at 30th June were estimated at 92,000,000 tons, averaging 3.67 percent copper. Further drilling has indicated substantial additions to these reserves, but no estimates are yet available. Boreholes have defined the extension of the strike of the south orebody as about 5,000 feet, but further drilling to the deeper levels is to be effected to prove the extent of the additional reserves. The first phase of sinking the first two hoisting shafts has been completed; sinking the third hoisting shaft has now commenced.

FRENCH EQUATORIAL AFRICA—*Pacific Tin Consolidation Corporation* has received the approval of the French government concerning a subsidiary company's agreement with the *Compagnie Miniere de l'Oubanghi Oriental* on development of a diamond property in French Equatorial Africa. Preparations are now being made for an exploration program, and studies are being made on methods of recovery and design of suitable dredging equipment.

FEDERATION OF RHODESIA & NYASALAND—*Anglo-Transvaal Consolidated Investment Company, Ltd.* and its associate companies—*Middle Witwatersrand* and *Rooderand Main Reef*—have formed *Anglovaal Rhodesian Exploration Company (Private) Ltd.* with headquarters in Salisbury. Anglo-Transvaal Consolidated has also interested itself in a number of mineral prospecting ventures in Southern and Northern Rhodesia, including the *North Charterland Concession.*

SOUTH WEST AFRICA—A Canadian group reportedly will back a Johannesburg, South Africa investment trust in a venture in South West Africa. The new concession will be to prospect for diamonds, other precious stones, and base minerals. It will extend 800 yards from the high-water mark into the sea in the Warmbad district. It is expected that considerable technical and legal difficulties will have to be overcome because the concession holders will have to obtain permission to travel through *Consolidated Diamond Mines of South West Africa* property and organize policing with them.

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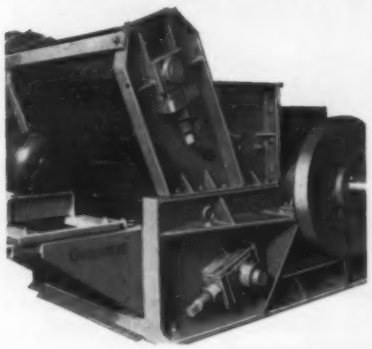
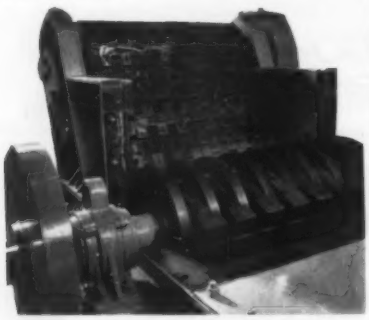


Force feed for wet sticky ore

With non-clogging discharge. Traveling breaker plates have 20 to 30 times the life of ordinary units.



Top housing removed for inspection

Note heavy swing impact hammers, balanced rotor and antifriction main bearing.

72,-60,-50,-36 inch diameter units Tremendous Crushing Capacities

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U.S.A. Metal & Mineral Prices

METALS

		January 21, 1957
COPPER:	**Electrolytic.** Delivered F.o.b. cars, Valley basis	36.00¢
	Lake. Delivered, destinations, U.S.A.	36.00¢
	Foreign Copper. Valley basis	36.00¢
	Custom	36.00¢
LEAD:	**Common Grade.** New York	16.00¢
ZINC:	**Tri-State Concentrates, jig, flotation 80% lead,** per ton	$201.32
	Prime Western: F.o.b. E. St. Louis	13.50¢
	Prime Western; Delivered, New York	14.00¢
	Tri-State Concentrate, 60% zinc, per ton	$84.00
ALUMINUM:	**Primary 30 Pound Ingots (99% plus).** F.o.b. shipping points	27.10¢
ANTIMONY:	**Lone Star Brand.** F.o.b. Laredo, in bulk	33.50¢
BISMUTH:	(In ton lots) price per pound	$2.25
CADMIUM:	**Sticks and bars. 1 to 5 ton lots (Price per pound)**	$1.70
COBALT:	**97.99%,** keg of 550 pounds (Price per pound)	$2.35
COLUMBIUM:	**Powder** Nom., per pound	$120.00
LITHIUM:	98% (per pound)	$11.00-$14.00
	Carbonate	82.00¢
MAGNESIUM:	**Ingots (99.8%)** F.o.b. Valasco, Texas, per pound	36.00¢
MERCURY:	**Flasks.** Small lots, New York	$255.00-$257.00
NICKEL:	**"F" Ingots (5 pounds).** F.o.b. refinery, Port Colbourne, Ontario	74.00¢
SELENIUM	**99.5%,** per pound	$13.50-$15.50
THORIUM:	per kilogram.	$43.00
TIN:	**Grade A Brands.** New York (Price per pound) Prompt delivery	$1.0225
TITANIUM:	**99.3%** + Grade "A" Sponge (Price per pound)	$2.75
URANIUM:	**Nominal, per kilogram**	$40.00
U-235:	**Nominal,** per kilogram	$11,000.00
GOLD:	**United States Treasury Price**	$35.00 per ounce
SILVER:	**Newly mined domestic.** United States Treasury price	90.5¢
	Foreign Handy Harmon	91.37¢
PLATINUM:	**Per Ounce**	$103.00-$105.00
ZIRCONIUM:	**Sponge, Per Pound,** Nominal	$10.00

ORES AND CONCENTRATES

BERYLLIUM ORE:	**10 to 12% BeO.** F.o.b. mine, Colorado	$45.00 per unit
	Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at: 8.0 to 8.9% BeO. $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $50.	
CHROME ORE:	**F.o.b. railroad cars eastern seaports. Long tons dry weight.**	
	African (Rhodesian). 48% Cr_2O_3. 3 to 1 Ratio	$55.00-$56.00
	African (Transvaal). 48% Cr_2O_3. No Ratio	$38.00-$39.00
	Turkish, 48% Cr_2O_3. 3 to 1 chrome-iron ratio	$58.00
	U. S. Government ore purchase depot Grants Pass, Oregon, Base price, lumpy ore, $115.00; fines and concentrates $110.00 for 48% Cr_2O_3 and a 3 to 1 chromium-iron ratio. Premiums for higher grade are and for a ratio up to 3.5 to 1. Penalties for grades down to 42% Cr_2O_3.	
COLUMBIUM-TANTALUM ORE:	**At United States small lot beryl purchase depots.** $3.40 per pound contained combined pentoxides in 50% ore. Includes 100% bonus. (Government stopped buying temporarily May 12)	
	Per Pound Pentoxide.	$1.15-$1.30
IRON ORE:	**Lake Superior. Per gross ton Lower Lake Ports**	
	Mesabi, Non Bessemer, 51.5% Fe.	$10.85
	Mesabi, Bessemer, 51.5% Fe.	$11.00
	Old Range Non Bessemer.	$11.10
	Old Range Bessemer.	$11.25
	Swedish, Atlantic Ports, 60 to 68% Fe. Contracts, Per Unit	28.00¢
MANGANESE ORE:	**Metallurgical grade.** 48 to 50% Mn. Long ton unit	$1.60-$1.75
	Metallurgical grade. 46 to 48% Mn. Long ton unit	$1.55-$1.65
	Metallurgical grade. 44 to 46% Mn. Long ton unit	$1.45-$1.55
	Domestic U. S. Government ore purchasing depots: Butte, Montana, (black and pink ores) base price of $4.87 per long dry ton of 18% manganese ore. Phillipsburg, Montana; base price of $6.43 per long ton unit of 15% manganese ore. Small lot program f.o.b. railroad cars, minimum 40% Mn. Base price (48%) $2.30 per unit with premiums and penalties.	
MOLYBDENUM CONCENTRATE:	**90% MoS_2 F.o.b. Climax, Colorado. Per pound of contained** molybdenum, plus cost of containers	$1.10
TUNGSTEN CONCENTRATE:	**Domestic.** 60% WO_3 Per short ton unit	$55.00
	Foreign. 65% WO_3 Per short ton unit (Scheelite)	$29.00
	Foreign. South American, Spanish, Portuguese	$28.00
URANIUM ORE:	**Carnotite-Roscoelite.** F.o.b. purchase depot plus $0.06 per ton mile ($6.00 maximum), **Grand Junction, Rifle, Durango, Naturita and Uravan, Colorado. Salt Lake City, Marysvale, Thompsons, Moab, White Canyon Green River, and Monticello, Utah. Shiprock, and Grants, New Mexico, Edgemont, S. Dakota, Riverton, Wyoming, Tuba City, and Cutter, Arizona.** Base price for 0.10% ore is $1.50 per pound and up to $3.50 per pound of contained U_3O_8 plus $0.75 per pound for each pound in excess of 4 pounds per short dry ton and an extra allowance of $0.25 per pound for each in excess of 10 pounds. A $0.50 per pound development allowance paid on all ore purchases. Special lime schedule applies at Monticello, Moab and Grants. No lime penalty with no vanadium payment or lime penalty with vanadium payment.	
VANADIUM ORE:	**Carnotite-Roscoelite. V_2O_5 in ratio of more than 10 parts to 1 part of U_3O_8 are generally acceptable at all AEC depots, but excess not paid for at Marysvale, Monticello, and Bluewater. Shiprock has no limit on V_2O_5 to U_3O_8 ratio** and all contained V_2O_5 is paid for Per Pound V_2O_5	$0.31

NON-METALLIC MINERALS

BENTONITE:	**Minus-200-mesh.** F.o.b. Wyoming points. Per ton in carload lots	$12.50
	Oil Well grade. Packed in 100 pound paper bags	$14.00
FLUORSPAR:	**Metallurgical grade. 70% effective CaF_2 content** per short ton F.o.b. Illinois-Kentucky mines	$40.00
	Mexican. 70% f.o.b. border	$24.00-$24.50
	Acid Grade. 97% CaF_2, Bulk, F.o.b. Kentucky, Illinois, Colorado	$55.00
	Government buying f.o.b. producer's shipping point: 60% Illinois-Kentucky, $34.50 per ton, others $28.50; 70% Ill.-Ken. $38.50, others $32.50.	
PERLITE:	**Crude:** F.o.b. mine per short ton	$3.00 to $5.00
	Plaster grades. Crushed and sized. F.o.b. plants	$7.00 to $9.00
SULPHUR:	Long ton, F.o.b. Hoskins Mound, Texas	$25.50
	Export	$30.50

LONDON METAL AND MINERAL PRICES

			January 21, 1957 Per Long Ton	USA Equivalent cents per pound[1]
COPPER:	**Electrolytic spot**		£269	10s 0d	33.69¢
LEAD:	**Refined 99%**		£116	10s 0d	14.56¢
ZINC:	**Virgin, 98%**		£103	15s 0d	12.97¢
ALUMINUM:	**Ingot, 99.5%**		£197	0s 0d	24.625¢
ANTIMONY:	**Regulus, 99.6%**		£222	10s 0d	27.81¢
TIN:	**Standard, 99.75%**		£790	0s 0d	98.75¢
TUNGSTEN:	**Long ton unit 215 S**		$30.10		

With Sterling pound at $2.80.

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, N. Y.*

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2A	34"	515#
AB	36"	744#
AB	42"	812#
AB	48"	951#
AB	54"	1064#
2B	36"	1280#
2B	42"	1395#
2B	48"	1520#
2C	60"	2360#

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1—Model HD-19 Cummins Tractor

1—Model TD-24 International Tractor

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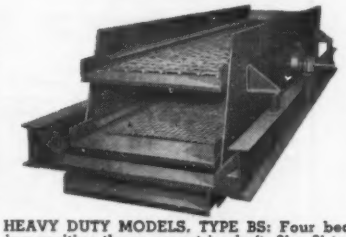
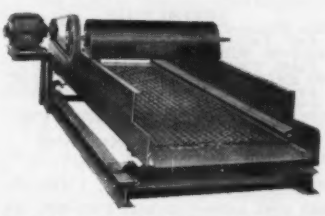


HEAVY DUTY MODELS, TYPE BS: Four bearing positive throw eccentric shaft; 3' x 6' to 5' x 14', 1 to 5 decks. Write for New 8-page Bulletin No. 1087.

Model Number	Screening Area	No. of Decks	Sale Price
124AS	2' x 4'	1	$ 443
224AS	2' x 4'	2	472
126AS	2' x 6'	1	472
226AS	2' x 6'	2	501
136AS	3' x 6'	1	581
236AS	3' x 6'	2	688
336AS	3' x 6'	3	956
138AS	3' x 8'	1	675
238AS	3' x 8'	2	815
338AS	3' x 8'	3	996
336BS	3' x 6'	3	1303
436BS	3' x 6'	4	1447
138BS	3' x 8'	1	1231
238BS	3' x 8'	2	1282
338BS	3' x 8'	3	1375
248BS	4' x 8'	2	1865
348BS	4' x 8'	3	2035
2410BS	4' x 10'	2	1953
3410BS	4' x 10'	3	2305
2412BS	4' x 12'	2	2319
3412BS	4' x 12'	3	2635
4412BS	4' x 12'	4	2833

NEW BONDED® GENERAL DUTY VIBRATING SCREENS



GENERAL DUTY SCREENS, TYPE AS. Eccentric weight mechanism, spring mounted, 1 to 3 decks, 2' x 4' to 3' x 8'. Write for New 8-page Bulletin No. 1086.

For mineral, chemical and other industrial products. Fast, efficient and economical for cleaning, sizing, grading, dewatering. Made in all metals including stainless steel. Enclosed models for hot materials or dust control. Bonded screens are built for any screening operation, wet or dry.

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Complete Ready-Fab sections quickly and easily joined together on the job. We take our loss on our stock of short length belting. You can save as much as 50% on the BONDED CONVEYOR SPECIALS listed, with conveyor belting in two pieces. Conveyors are equipped with 5" roll diam. idlers and return rolls, 20" diam. head pulley and 16" diam. tail pulley mounted on 2 1/4" or 2-7/16" diam. shaft. Belt is new 4-ply, 28-oz. duck, 1/8" top rubber cover x 1/32" bottom cover and is fresh stock made by leading manufacturers.

You Save "Up To 50%

Conveyor Prices Include Belting

Belt Width	Length of Conveyor	List Price	Sale Price
14"	25'	$1397	$ 722
14"	50'	2222	1144
14"	85'	3377	1733
16"	20'	1262	636
16"	45'	2137	1088
16"	60'	2662	1359
16"	90'	3712	1900
18"	25'	1477	794
18"	45'	2217	1166
18"	70'	3142	1648
18"	85'	3697	1933
18"	100'	4252	2220
18"	130'	5362	2797
20"	25'	1517	828
20"	60'	2882	1533
20"	75'	3467	1838
20"	90'	4052	2145
24"	25'	1590	898
24"	45'	2430	1330
24"	70'	3480	1875
24"	100'	4740	2514
24"	120'	5580	2950
24"	150'	6840	3603
30"	50'	2911	1617
30"	70'	3871	2119
30"	90'	4831	2614
36"	25'	1818	1118
36"	45'	2858	1678
36"	60'	3638	2096
36"	100'	5718	3214

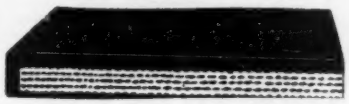
For conveyors longer or shorter than those listed above, add or deduct the following per foot prices according to belt width. Prices include belting.

For 14" belt	$16.84 per foot
For 16" belt	18.04 per foot
For 18" belt	19.24 per foot
For 20" belt	20.37 per foot
For 24" belt	21.78 per foot
For 30" belt	24.75 per foot
For 36" belt	27.95 per foot

Write For Bulletin #1138

NEW CONVEYOR BELTING SAVE UP TO 25%

Heavy duty 4-ply, 28 oz. duck 1/8" top rubber cover by 1/32" bottom cover 12# to 15# average friction pull; 800# to 1000# average cover tensile rubber belting having high tensile strength, tough cotton duck, strong carcass and proper flexibility. For heavy boxes, bags and bulk materials. Troughs easily. Famous brands at deep cut prices. Fresh stock.



Width	Ply	List Price	Sale Price
14"	4	$3.52	$2.83
16"	4	3.96	2.97
18"	4	4.38	3.29
20"	4	4.83	3.80
24"	4	5.68	4.26
30"	4	6.97	5.21
36"	4	8.26	6.18

A high grade of heavy duty 4 and 5-ply, 28 oz. duck, 1/8" top rubber cover x 1/32" bottom rubber cover, 16# to 19# average friction pull, 2500# to 3000# average cover tensile belting, skim coat between plies. This belt is for more severe services, high tonnages and abrasion resistance. For handling stone, mineral ores, concrete, cement, coal and other similar materials, both wet and dry. Belt has molded rubber edge.

Width	Ply	List Price	Sale Price
16"	4	$4.71	$3.46
18"	4	5.23	3.83
20"	4	5.73	4.37
24"	4	6.74	4.94
30"	4	8.28	6.07
24"	5	7.90	5.78

The following belts are 5-ply, 32 oz. ducks:

Width	Top Cover	Bottom Cover	List Price	Sale Price
24"	1/8"	1/16"	$ 8.56 ft.	$ 6.42 ft.
30"	1/8"	1/16"	10.52 ft.	7.89 ft.
36"	3/16"	1/16"	14.21 ft.	10.66 ft.

BONDED TROUGHING IDLER CONVEYORS ARE ALSO AVAILABLE WITH TRUSS TYPE CONSTRUCTION. WRITE FOR DESCRIPTIVE INFORMATION AND PRICES.

NEW IDLERS AND RETURN ROLLS 25% BELOW LIST PRICE

Troughing Idler

3-roll, 5" diameter Troughing Idlers for:			
14" belt	$18.50	24" belt	$21.25
16" belt	19.25	30" belt	22.00
18" belt	20.50	36" belt	22.75
20" belt	20.75	48" belt	25.50
1-roll, 5" diameter Return Idlers for:			
14" belt	$7.25	24" belt	$ 8.50
16" belt	7.50	30" belt	9.50
18" belt	8.00	36" belt	10.00
20" belt	8.25	48" belt	11.50

All steel. Interchangeable with other well-known makes. Furnished with easily replaceable pre-lubricated Sealed ball bearings. Also can be furnished with greaseable type Alemite Fitted bearings at slight additional cost. Maintenance is negligible.

NEW BONDED HEAVY DUTY ABRASION PLATE FEEDERS

Bonded HDF-18 Heavy Duty Feeders were especially designed for abrasive materials such as Ore, Rock, Crushed Stone, Gravel, Sand, Clinkers, Abrasive Volcanic Ash and Rock. Abrasion Resistant Alloy Steel Plate is used for all parts that contact the material. Feeders are process control instruments as well as material movers and help to prevent Screens, Crushers, Grinders, etc. from being run empty, choke-fed or overloaded. Capacities to 250 tons per hour. Write for Bulletin #1182.

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HARDINGE MILLS—4'6"x16", 6'x16", 6'x22", 6'x36", 7'x22", 8'x36", 8'x48", 10'x48".
ROD MILLS—12"x24" LAB., 3'x10', 4'x8', 4'x9', 4'x14', 5'x8', 5'x10', 5'x14', 6'6"x14', 8'6"x12'.
TUBE MILLS—5'x14', 5'x22', 5'6"x22', 6'6"x21'.

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OLIVER DRUM—8'x10', 12'x14', 14'x18', 11'6"x 18'.
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KILNS—6'x28', 6'x7'x80', 8'x125', 10'x105'.

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BLAKE TYPE—66"x84", 36"x48", 30"x36", 24"x36", 18"x36", 10"x32".
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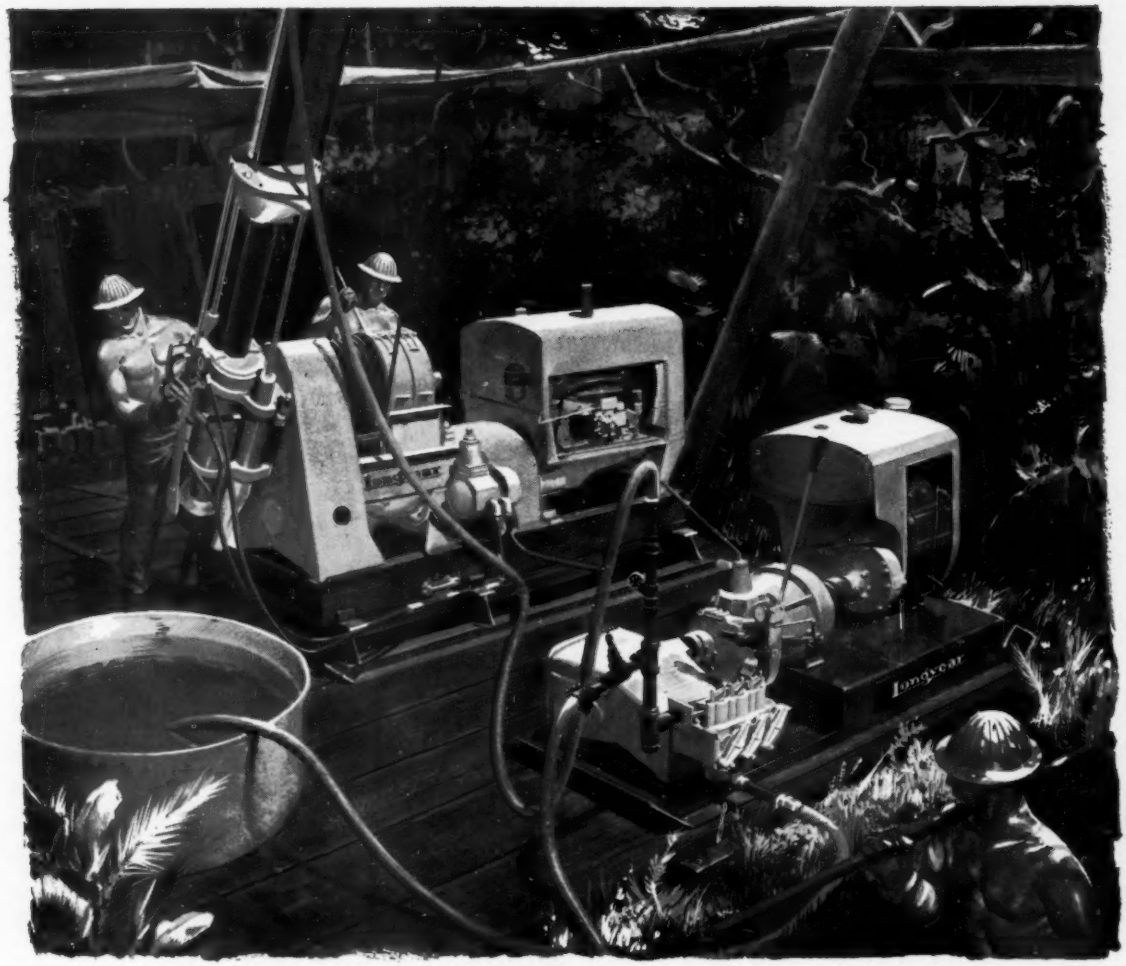

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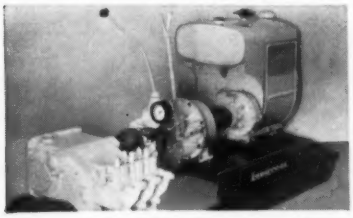

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